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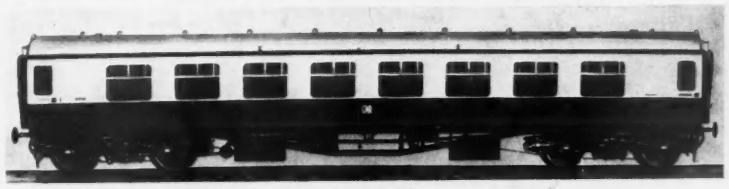

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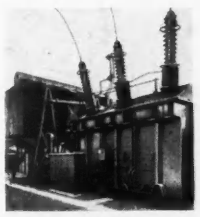

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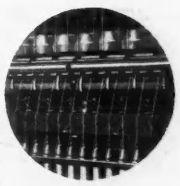

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A Seven-Day Journal

A Progress Report

IN a postscript broadcast on Thursday evening, August 22nd, the Minister of Supply, Mr. Herbert Morrison, spoke to those engaged in the management and work of the Royal Ordnance Factories and the building trades, giving what he termed a short progress report. In introducing his subject Mr. Morrison said that while we had not caught up the enemy, considerable progress had been recorded, and he went on to give particulars of some of the work connected with the building, equipping and starting of the Royal Ordnance Factories, which form part of our defence measures. One factory, he said, was now standing in what in April last was a green field. It was scheduled to begin operations in December next, but machinery was started in the factory at the beginning of the present month, and there were now fifty men at work. What was to have taken eight months has been done in four. In another factory, where building operations only began in May last, machine tools were now being installed and training had now begun. In the case of two other factories, which were, according to the original plan, to have been ready for production at the end of the present year, one was just getting its first workmen and the other was now beginning operations. In another factory in which production was to have begun next month, a good beginning had already been recorded with an output of one million rounds of small arms ammunition in the first week in August. In the case of another ordnance works, which produced its first test shell late in June, according to a normal rate of progress, it would have been reasonable to expect such a factory to be producing by now shells at the rate of 1000 per week. Actually in the middle of August no less than 3500 shells per week were already being turned out. In still another factory it was planned to begin output by April next, but the progress in building and equipment had been so rapid that it would begin in three weeks' time, seven months ahead of the date originally scheduled. The general position, Mr. Morrison concluded, was that whereas according to the original plan the factories referred to should have reached about a quarter of their production capacity by next March or April, so far as he could see they should then be turning out practically 100 per cent. of the large capacity for which they were planned.

A Mission to India

ON Tuesday, August 27th, the Minister of Supply, Mr. Herbert Morrison, announced that consideration had recently been given by the Ministry of Supply, the India Office, the Government of India and the War Office to the question of the most effective steps that can be taken to expand the production in India of munitions and other stores required by the Forces. The general object is to enable India not only to meet her own needs for home defence, but to make an even greater contribution than she does to-day to the general war effort of the Empire, and in particular to the equipment and supply of the Forces in the Middle East and east of Suez. In order that the Home Government may be kept closely in touch with India's problems and requirements, and in order that the Government and the Government of India may be advised as to the most useful action to take in order to assist India in increasing her output, he has, in consultation with the Secretary of State for India and the Viceroy, appointed a special mission under the chairmanship of Sir Alexander Roger, which has recently left and is now on its way to India. The task of increasing India's arms industry will need to be considered in relation to the existing and potential arms output of the other Empire countries in the eastern hemisphere—Australia, New Zealand, South Africa, Southern Rhodesia, Burma, Hong Kong, Ceylon, Malaya and the East African territories. For that reason it is fortunate that, as has already been announced, a conference of representatives of these countries, at the invitation of the Viceroy of India, will be meeting at Delhi during the time of the Ministry of Supply mission's stay in India. That will simplify the task of relating plans for India's arms expansion to the capacities of the other Empire countries in that part of the world, and to the wider strategical requirements of our Forces in the East and Near East. In pursuance of the same object, and at the request of the Government of the Union of South Africa, the Ministry of Supply mission will take advantage of its call at Cape Town *en route* for India to study the munitions capacity of South Africa in consultation with the Union authorities.

Higher Railway Charges Inquiry

THE first session of the public inquiry into the proposed increase in railway fares needed to meet increased working costs, mentioned in our issue of August 16th, was held at Brooklyn Hall, Bush House, Aldwych, on August 26th. The inquiry, we may recall, is being held by the Charges (Railway Control) Consultative Committee, to which the proposals of the Railway Executive Committee have been submitted by Sir John Reith, the Minister of Transport. The Chairman of the Committee is Mr. W. Bruce Thomas, K.C., and the other members are Mr. H. E. Parkes and Mr. J. Quirey. Opening the inquiry, the Chairman said that the Committee had to consider two matters. They were the appendices to the letter from the Minister of Transport, which he read to the meeting, containing the estimates of the Railway Executive, and the best way of increasing the charges from October 1st next, so as to yield by September 30th, 1941, a sum which, together with the increase already made or authorised, would amount to about £44,500,000. Several speakers asked that an adjournment of two months should be allowed to prepare and submit a proper opposition. These included Mr. Harold Heath, representing the London Passengers' Transport Alliance, and Mr. A. S. Comyns Carr, K.C., representing the Mining Association of Great Britain, the Monmouthshire and South Wales Coalowners' Association and the National Association of Coke and By-product Plant Owners. Mr. Moelwyn Hughes spoke for several local authorities, including the London and Middlesex County Councils, and supported the proposed adjournment. The Chairman said that an adjournment at some stage might be necessary, and probably was necessary, but the Committee did not think that it should be granted at the present stage. Mr. Alfred Taylor spoke for the Railway Executive and Mr. T. E. Thomas, the general manager of operations for London Transport, presented the case for the London buses, trams and trolleybuses. On Tuesday the inquiry was resumed and reference was made to the decline in London traffic since intensive air raids had started over London. The inquiry was adjourned until Monday, September 2nd.

Fleet Air Arm Successes

IN the many returns of successes achieved by the Royal Air Force in bringing down enemy aircraft, which are published by the Air Ministry, no connected account has been given of the enemy machines which have been brought down by the Fleet Air Arm or by the anti-aircraft guns of naval vessels. It is not always possible to publish Fleet Air Arm results with those of the Royal Air Force, since many of these aircraft have been in operation in Norwegian and Mediterranean waters, in areas which do not come into the purview of the Royal Air Force commands. The latest returns of the Fleet Air Arm show that up to Monday, August 12th, the anti-aircraft guns of the Royal Navy had shot down for certain 122 German and Italian aircraft. Besides these machines there are sixty-four others which are believed to have been destroyed, but which have not been so classified, as their actual destruction was not witnessed. That figure, it is pointed out, most likely represents a larger number of real losses than is usually the case, as many of the engagements relate to operations in Norway, where the damaged aircraft nearly always disappeared behind mountains. In addition to the figures quoted above, there must be added to the total a further forty-five seriously damaged aircraft. In the same period it is reported that fighter aeroplanes of the Fleet Air Arm shot down for certain twenty-eight enemy aircraft and at the same time inflicted damage on more than twenty-five other aircraft, several of which should be regarded as probable losses. The report bears testimony to the good shooting of the naval anti-aircraft gunners and the crews of the Fleet Air Arm.

A Clyde Committee of Inquiry

ON Saturday, August 24th, it was announced that the Minister of Transport, after consultation with the Minister of Labour, has appointed a Committee of Inquiry under the chairmanship of Lord Patrick, one of the Senators of H.M. College of Justice in Scotland, with the following terms of reference :—"To consider the position at Glasgow docks in all its aspects and to make recommendations thereon with a view to the most efficient working of the port during the war." In addition to Lord Patrick, the Minister has invited the following members to complete the Committee :—Mr. Reginald C. Biddle, M. Inst. T., docks and marine manager of the Southern Railway at Southampton, and Mr. George W. Thompson, of the Association of Engineering and Shipbuilding Draughtsmen, member of the General Council of the Trades Union Congress, and representative of the General Council of the Trades Union Congress on the National Joint Advisory Council. The Secretary will be Mr. G. F. Sayers, of the Ministry of Transport. The object of the inquiry is to ensure that the best possible use is made of the Port of Glasgow in the exceptional circumstances which have been created by the war. Under the war-time organisation of its Port Emergency Committee, the port has played an important part in the national effort and as new problems arise from time to time which call for special consideration it is desired to ensure that its efficiency is fully maintained. The problems are related to all the elements which combine in the operation of a port such as Glasgow, namely, the Authority, the employers, and labour. All aspects of the functions of these groups will have to be taken into account by the Committee. There is no suggestion of criticism of any of the sections mentioned; it is desired to obtain authoritative opinion as to what is necessary to meet the particular requirements of the war-time situation. It is requested that anyone who desires to give evidence before the Committee should communicate at once with the Secretary, the Central Station Hotel, Glasgow. The inquiry began at the Central Station Hotel, Glasgow, on Tuesday, August 27th.

Army Works Contracts

IN a memorandum which has been drawn up by the War Office in reply to observations contained in the third report of the Select Committee on National Expenditure, and which is contained in the Select Committee's eleventh report just published by the Stationery Office, it is announced that a new Committee has been set up to advise the Army on building questions. The Committee is also to advise on the placing of works contracts and the supervision of works in progress. The Chairman of the Committee is Mr. J. Jameson, and the other members are Mr. M. T. Tudsbery, M. Inst. C.E., Mr. C. E. Elcock, F.R.I.B.A., and Mr. A. S. Ainsley. The terms of reference laid down for the Committee should allow it to consider several questions which were the subject of recommendations by the Select Committee. They include the supervision of work on building sites, the use of civilian technical staffs, the provision of full information to contractors before the work is begun, and the securing for contractors of as great a latitude as possible in the specification of the forms of construction which may be employed.

Unemployment in the Shipbuilding Industry

SPEAKING in the House of Commons on Thursday, August 22nd, and replying to a question put by Mr. David Kirkwood, as to why there was still unemployment in the shipbuilding industry, and what steps were being taken to meet it, Mr. Ralph Assheton, the Parliamentary Secretary to the Ministry of Labour, gave some interesting figures. He said that the total number of male persons aged eighteen years and over recorded as unemployed in the skilled occupations of the shipbuilding and ship repairing industry in Great Britain at July 29th was 1710. Representatives of employers and workpeople in the industry have co-operated with the Ministry of Labour in reviewing the cases of all workers who were registered as unemployed in certain skilled shipbuilding and ship repairing occupations at the main shipyard exchanges on June 3rd last, and who had not obtained employment before their cases were due to be reviewed. Of the 1218 men whose cases were so examined, 831 were, in the opinion of the panels, suitable for employment in shipbuilding or ship repairing either directly or after being given the opportunity of refitting themselves for the work. Steps were being taken to ensure that any of these men who have not since obtained employment are absorbed in the industry without delay. With regard to the question whether it was now proposed to pay workers transferred in the national interest from one yard to another their fares and subsistence allowances, Mr. Assheton said that the workers transferred by employment exchanges since June 1st last to work of national importance beyond their daily travelling distance now received travelling allowances, and married men, or single men with similar responsibilities, who continue to maintain a home in the town from which they are transferred, were entitled to a lodging allowance at the rate of 3s. 6d. per night.

Engineering Training Facilities

WE are given to understand that good progress is being made with the Ministry of Labour's schemes for training men for engineering work. It is announced that the number of those in training has doubled since early June, and that the total is now about 17,000. That figure represents a weekly increase of about 1000, which is regarded as satisfactory. With the existing training centres it is stated that the number of men under training could be increased to at least 35,000, and the centres could be even further extended. At the moment, however, extensions to training work are being retarded by the lack of instructors. In order to secure more instructors, the Ministry of Labour has decided to increase again the salary of the ordinary instructor. The salary is to be £350 per year, with annual increments of £10 rising to £375. Instructors will be liable for night duty. In seeking to increase the number of instructors every assistance has been given by the employers' organisations and the engineering trade unions. The type of man needed for this work is a first-class craftsman, who can put his practical knowledge at the disposal of those he is called upon to teach. The average length of training is rather less than four months.

Developments in Air-Break Circuit Breakers

No. II

(*Continued from page 126, August 23rd*)

THE success attained with the 400-volt air-break circuit breaker of high breaking capacity, such, for instance, as the panel mounted unit shown in Fig. 10, has led to the extension of the fundamental principles involved to the higher

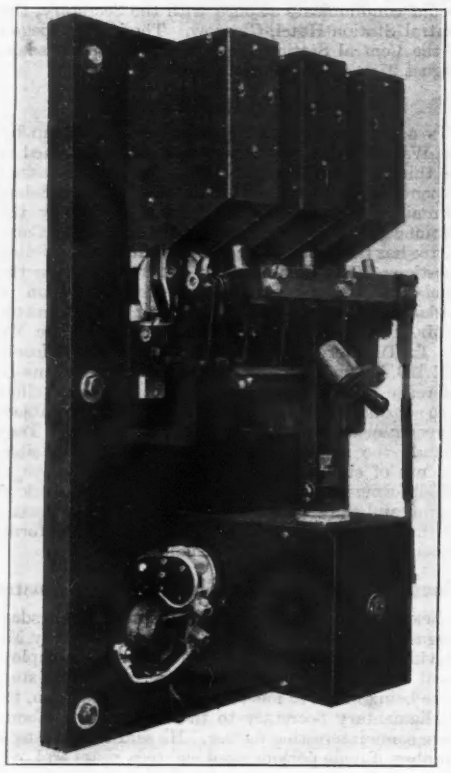

FIG. 10—PANEL MOUNTED 400-VOLT AIR CIRCUIT BREAKER

voltage ratings. This has necessitated a new contact arrangement to incorporate arc transference and a new de-ionising chamber for dealing with the larger powers and the higher pressures. At the increased voltages higher rupturing capacities

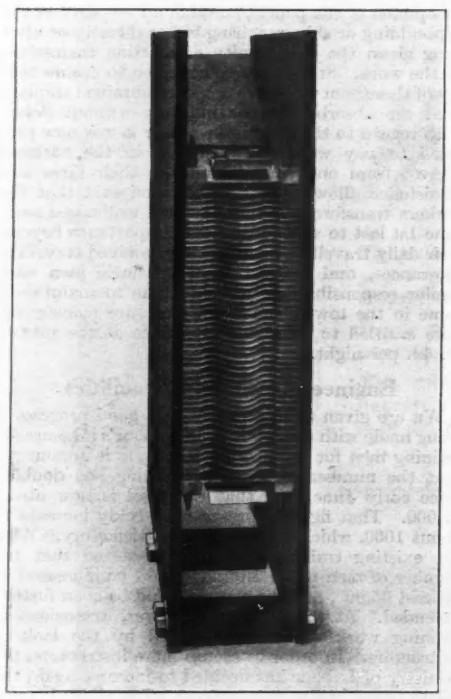

FIG. 11—BOTTOM VIEW OF 3300-VOLT ARCING CHAMBER

became necessary, involving means for moving the arc promptly from the sparking contacts to the de-ionising chamber, introducing voltage into the arc in a smooth but rapidly increasing manner, whilst ensuring speedy positive interruption.

In the English Electric Company's new 3300-volt circuit breaker these features are incorporated in the design, and as with the 400-volt arcing chamber, it has been possible to avoid the use of magnetic blow-outs which frequently introduce complications and difficulties in maintaining a high insulation level. The units are capable of performing a B.S.S. duty cycle without a liquid dielectric or other form of stored interrupting medium.

In the design of the arcing chamber (Fig. 11) for 3300 volts, there are a number of conducting plates of magnetic material, spaced at intervals of approximately ½in. apart, and at right angles to the arc, the arrangement allowing free ventilating space out to the top for the escape of gases, and keeping down the back pressure which would prevent the gas from rising freely. At the bottom the shaping of the plates facilitates the movement of the arc from the sparking contacts into the arcing chamber in a smooth and efficient manner, magnetic control being obtained by self-induction of the plates. At the top of the arcing chamber are a number of insulated plates with a larger spacing between them and giving no additional restriction to the arc or to its gases. In cooling the gases so that there is very little visible display of ionised arc or gases at the top of the arcing structure, this chamber has proved very effective.

Contrary to 400-volt schemes, where the arc is interrupted at the sparking contacts of the breaker, it has been found necessary with this design to incorporate transfer electrodes of good conducting material which extend practically the whole length of the arcing chamber. These electrodes are placed at the extreme ends at the back and front of the chamber. Difficulty was experienced with currents in the neighbourhood of 300 amperes and below in controlling the arc and extinguishing it within two or three half-cycles, but the trouble was overcome by the introduction of small air dashpots for buffering the moving contacts in the open position and which at the same time served to give a very small air supply to the bottom of the arcing chamber. This was found sufficient to cause the arc to transfer immediately from the sparking contacts to the arcing chamber electrodes, where it was brought under proper control.

With A.C. operation the arc is interrupted at an early current zero, but the arc drop is not high until the end of the arcing half-cycle. Normally there is only one to two half-cycles of arcing at the heavier currents, and a maximum of three half-cycles at the lighter currents. Breakers equipped with these interrupters have been successfully tested up to their maximum short-circuit capacity in earthed enclosures, having a top surface only 3in. above the arc chamber, which is also effective as a silencer. In the chamber the A.C. voltage drop is approximately 500 volts per inch R.M.S.

On the 400-volt tests it was observed that the operation of the air-break circuit breaker tended towards an easement in the severity of the circuit conditions, and this feature became apparent to a greater extent when testing the 3300-volt breaker. The results of this easement are shown in the graph, Fig. 12, which is a vectorial representation of the inherent easement in severity, actually effective within the arcing chamber. The diagram is set out with reference to the internal generator peak voltage, which is indicated along the vertical axis as being at each half-cycle of arcing, and is shown as constant in phase position and having a magnitude of 100 per cent. Upon the application of the short circuit, the initial current in the arc, which takes place at the sparking contacts, is of comparatively low power factor,

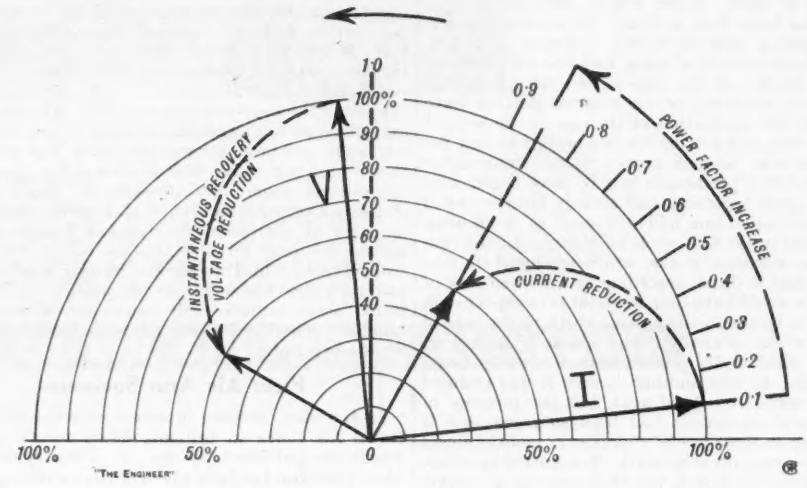

FIG. 12—GRAPH SHOWING INHERENT EASEMENT IN SEVERITY

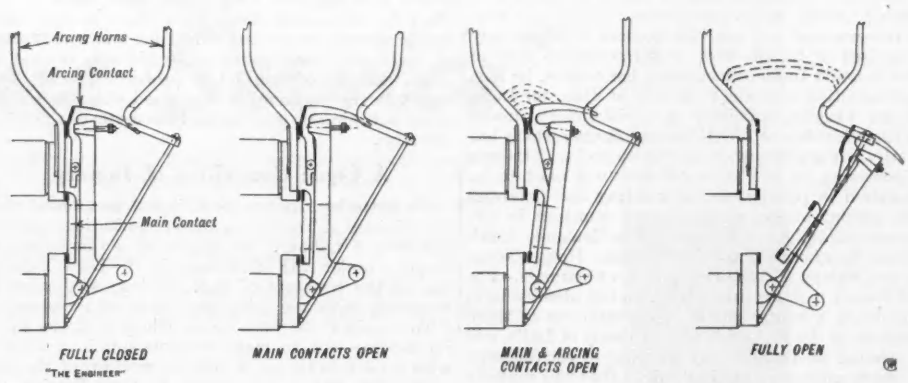

FIG. 13—OPENING SEQUENCE OF CONTACTS

until the arc is transferred to the transfer contacts in the arcing chamber. In the example shown, the circuit power factor is indicated as 0·1 and the initial current I is shown at the corresponding angle from the vertical ordinate.

At the first current zero after contact separation an instantaneous recovery voltage, V in the diagram, can appear across the breaker. This vector is only slightly removed from the peak voltage and the magnitude of the instantaneous recovery voltage is therefore approximately proportional to the generator peak voltage, thus submitting the breaker at this instant to the full severity of the circuit. But at the subsequent current zero, conditions are considerably modified.

The current is reduced to approximately half the initial value and the power factor is increased to, say, 0·8 to 0·9. As a result of this reduction in phase angle, the second current zero is advanced to a point of reduced instantaneous voltage. This change in the instantaneous recovery voltage in both magnitude and relative phase position is shown in the graph. The reduced value of the voltage is approximately 50 per cent. of the initial voltage and the effect of the severity on the circuit breaker is actually still further reduced, owing to the introduction of the arc resistance in damping the natural oscillations of the circuit.

The arc of an oil circuit breaker introduces very little resistance, with practically no improvement in phase angle, and such a breaker must withstand the full shock of the circuit recovery characteristics. Fig. 17 indicates the phenomena referred to in Fig. 12.

It was found necessary in the construction of 3300-volt breakers slightly to modify the three-stage arrangement used for interrupting the arc of the 400-volt breaker, and while the arc is extinguished in the same number of stages the sequence is slightly varied. As the order of current to be interrupted was approximately the same as that in the 400-volt breaker, it was possible to retain the same kind of operating mechanism, it being only necessary to introduce suitable operating links for the increased voltage. The contact arrangement shown in Fig. 13 consists of three stages, the first stage being the main contacts which serve to carry the load current. The second stage comprises the arcing contacts which serve to protect the main contacts from deterioration during interruption, and at the same time interrupting the arc. On the moving arm is carried the spring-loaded arcing contact, as well as the main contacts.

The arcing contact passes through a slot in the base of the front electrode in the arcing chamber, and has an extended tail which, while in the closed position, maintains the arcing contact in close proximity to this electrode. This arrangement facilitates the operation of the third stage of transferring the arc from the moving contact to the front electrode in the arcing chamber at an early period in the formation of the arc. In the arcing chamber the front electrode is also directly connected to the bottom terminal stud of the circuit breaker. The top terminal stud is connected to the back electrode and the final arc interruption is thus effected in the arcing chamber between the two electrodes. As the electrodes are made of good heat-conducting material, rapid movement of the arc in an upward direction is facilitated, causing the minimum deterioration to the materials used in the construction of the arcing chamber. In Figs. 14 and 15 the 3300-volt breaker with the arcing chamber removed is shown in the closed and open positions respectively. By the simple operation of releasing two bolts the arcing chamber is removed and the whole of the contact system exposed.

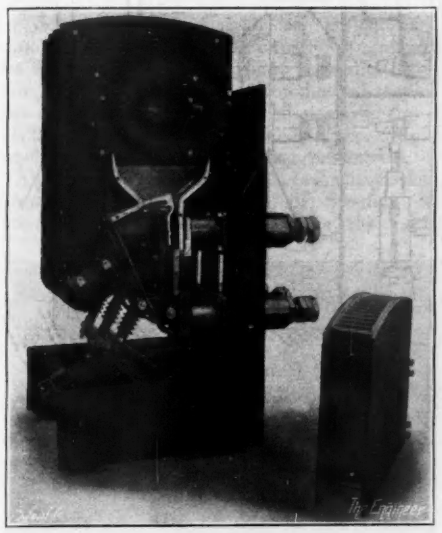

FIG. 14—3300-VOLT BREAKER IN CLOSED POSITION

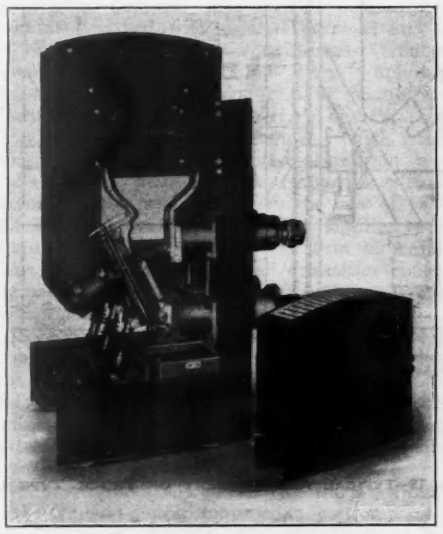

FIG. 15—3300-VOLT BREAKER IN OPEN POSITION

At voltages up to 5000 (50 cycles), single and three phase, short-circuit tests have been made, the current values ranging from a few amperes up to over 20,000 amperes. Symmetrical, R.M.S. breaking, and crest values of current of over 60,000 amperes have been dealt with on "making" shots. The oscillograms, Figs. 16 and 17, show how rapidly and smoothly the arc voltage increases and how the effective arc extinguishing action is attained. Arcing time is limited to approximately two half-cycles at both 100 and 10 per cent. duty cycles, whilst the breaker action provides an overall operation time of approximately five half-cycles.

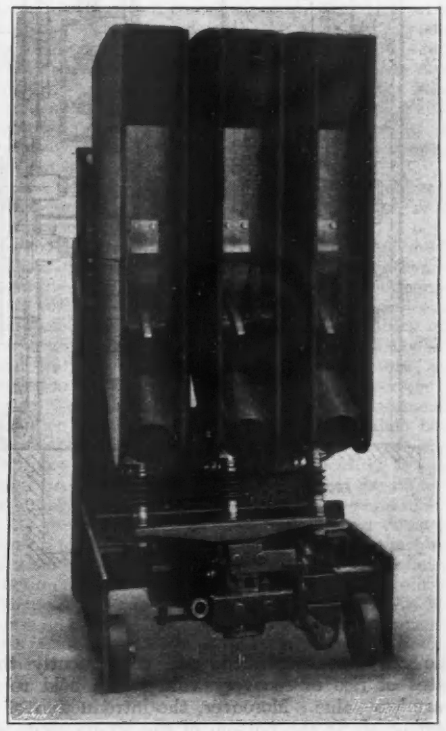

FIG. 18—3300-VOLT, 3-PHASE, 100 MVA AIR-BREAK CIRCUIT BREAKER AND TRUCK TYPE EQUIPMENT

A compact example of a circuit breaker mounted in a totally enclosed sheet steel housing and with the usual form of withdrawal truck type construction, which permits of the ready withdrawal of the unit for inspection and maintenance, is shown in Fig. 18. Alternatively, the breaker can be mounted in sheet steel cubicles suitably interlocked and without the withdrawal arrangement. In both cases complete mechanical interlocks are provided to give the usual protection against access to

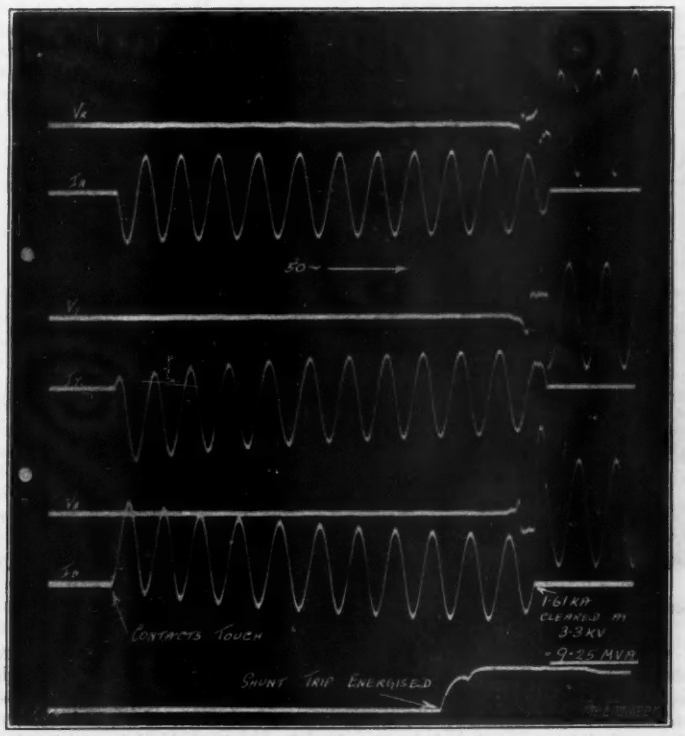

FIG. 16—3-PHASE, 3300-VOLT 10 PER CENT. "BREAK" SHOT SYMMETRICAL

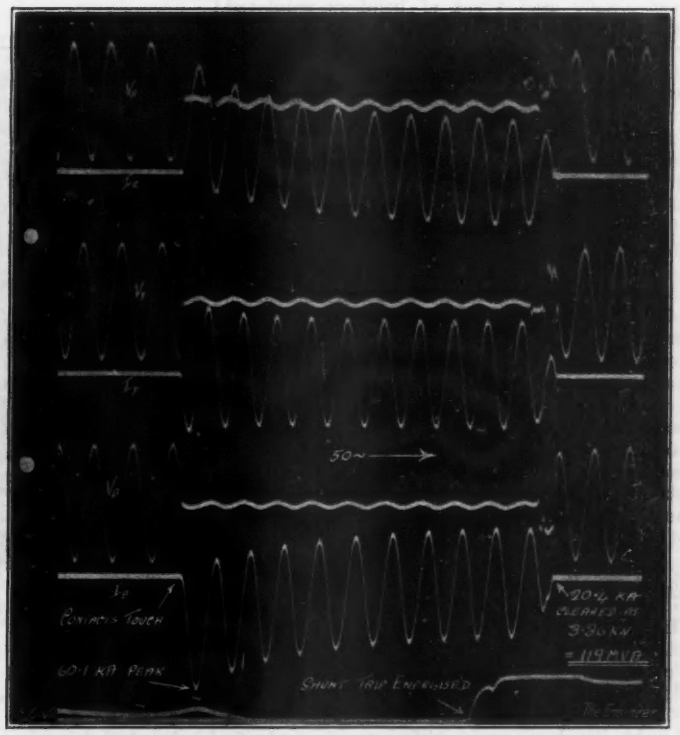

FIG. 17—3-PHASE, 3300-VOLT "MAKE-BREAK" SHOT SYMMETRICAL

live parts and to prevent "making" or "breaking" circuit on isolating contacts. In Fig. 19 a complete truck type equipment is shown.

By cooling and lengthening the arc and by efficient means of arc transfer this new air-break circuit breaker adds resistance to the circuit as the arc is extinguished, and consequently the rates of rise of recovery voltage are held to a harmless value. Moreover, the introduction of a puff of air at the bottom of the arcing chute at the instant of arc interruption has demonstrated that the breaker is suitable for opening the lowest possible values of current at very low power factors such as are met with as magnetising currents in power transformers. On an endurance test this English Electric circuit breaker has demonstrated that it has a long and economical life, and provides reliable circuit control. Without having to allow excessive clearance for the dissipation of the arc gas, the physical arrangement permits of the use of the circuit breaker in metal-enclosed compartments.

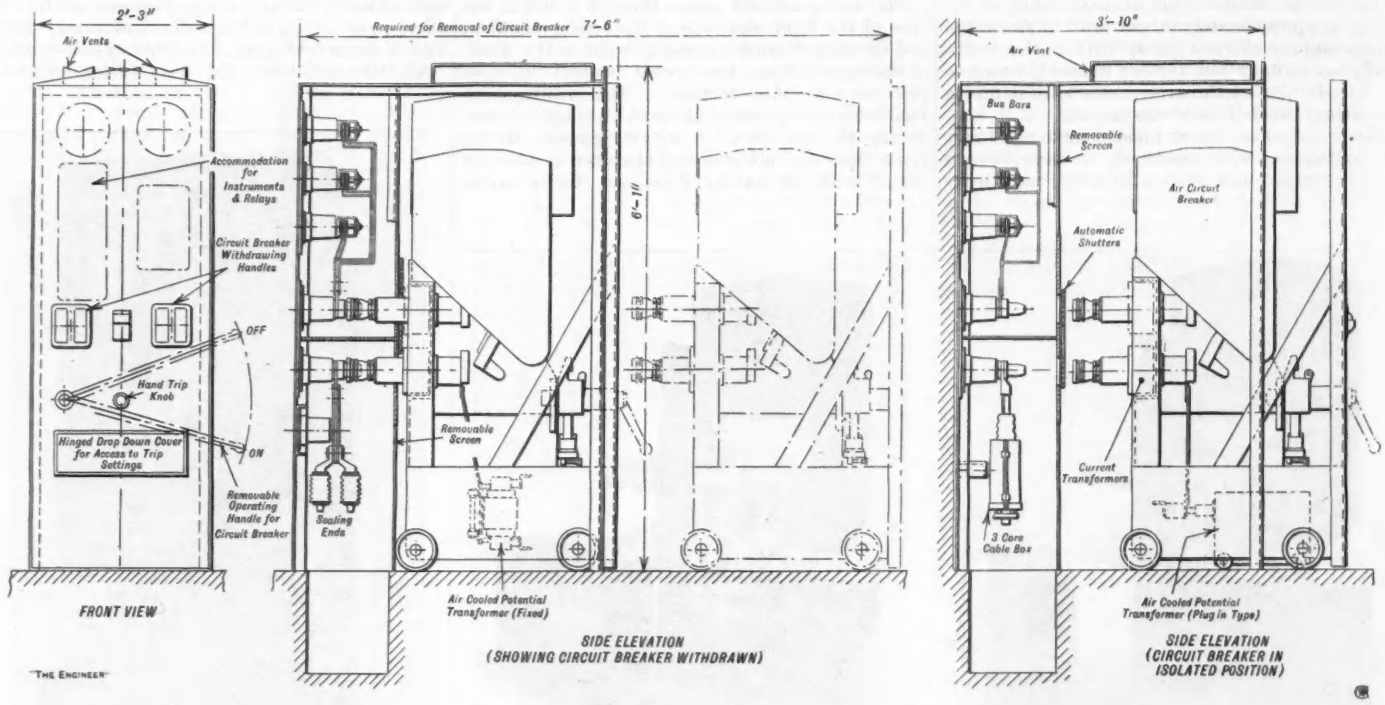

FIG. 19—TYPICAL ARRANGEMENT OF TRUCK TYPE UNIT

Air Force Targets in Germany

No. IV

(*Continued from page 92, August 9th*)

Junkers Aircraft Works at Dessau

ON Wednesday, August 14th, it was officially announced that in the night of Tuesday, August 13th, aircraft of the Royal Air Force Bomber Command heavily damaged the Junkers Aircraft Works at Dessau, where some of the most widely used types of bombers employed in the German Air Force are made. The works, which are situated about 60 miles to the south-west of Berlin, extend over many acres. They were systematically bombed by relays of aircraft for over an hour. During the greater part of the raid the moon was obscured by high clouds; but the parachute flares which were dropped by the raiding aircraft effectively illuminated the target and assisted the accurate observation of the damage resulting from the attack. Numerous direct hits were obtained with heavy calibre bombs in many parts of the target area. The crew of one machine, the bombs from which fell in a line across the main buildings, reported that one had hit and destroyed the main power-house. Other aircraft severely damaged the large assembly sheds and a big sheet metal shop, while another attack made from a height of only 1000ft. scored a direct hit on one of the large experimental shops, which immediately blew up. Herewith we reproduce photographic views of the main administration building of the Dessau works, and a night view of the heating and power-house.

In addition to the parent works at Dessau, there are branch works in different parts of Germany, which include those at Aschersleben, Halberstadt, Leopoldshall, and Leipzig. Besides these principal branch factories there are others near to the main works, and one of these—at Bernburg, some 20 miles to the west of Dessau—was raided by the machines of another squadron. At the Bernburg works airframes are made for the Junkers dive-bombers and the troop-transport machines. The works were attacked with salvoes of high-explosive and incendiary bombs, and severe damage was done. The aerodrome which adjoins the works and other buildings were also attacked.

The Junkers aeroplane factory at Dessau had its origin about 1910, when Professor Hugo Junkers was granted a patent for an "all-wing aeroplane." The underlying idea of the invention of Professor Junkers was to include the engines and their fuel system, and also the freight compartments and the passenger and crew accommodation, within the wing structure, so that the air resistance of the machine could be reduced to a minimum. This idea Junkers worked upon until 1915, when he produced the first all-metal Junkers monoplane. It was tested at Döberitz, near Berlin, in the September of that year. The development work which followed the first machine was continued with that thoroughness so characteristic of Professor Junkers' other work which, we may recall, had at that time been extended to the design and construction of gas and oil engines, an intensive study of the properties and methods of testing steels and light alloys used in aircraft construction, and work on heating and ventilation, which had resulted in a large business in water-heating apparatus and the success of the Junkers calorimeter for gaseous and liquid fuels. The work on the Junkers aircraft, and that on the Junkers engine for aeroplane propulsion was carried on simultaneously by two undertakings—the Junkers Flugzeugwerk A.G. and the Junkers Motorenbau G.m.b.H., both of Dessau. In the first machine, the "J 1," which was an experimental design, a low-wing cantilever monoplane system of construction was adopted, and tests were continued up to the end of the last war. An important change was the decision of Professor Junkers to dispense with steel alloys for body and wing construction, largely on account of the difficulties which welding at that time presented, and to go over to the light metal alloy "duralumin." That change necessitated the careful investigation of suitable sections of sheet and angles, and appropriate construction of both plain and corrugated plates which were

ADMINISTRATION BUILDING OF JUNKERS AIRCRAFT WORKS

successfully carried through in the Dessau workshops. One of the next machines was an armoured troop-carrying aircraft for army purposes, and by the end of the war in 1918 several aircraft were designed, built, and flown. It was not until after the war, in September, 1919, that the first all-metal commercial aircraft, the Junkers "J 13," designed to carry six passengers, was completed by the firm. Then followed a gap in production, owing to the Allied provisions connected with the Peace Treaty, which forbad the construction of aeroplanes in Germany. The period from 1921 until June, 1922, when the building of commercial aircraft was again permitted, were difficult years in the history of the Junkers firm, and the number of men employed fell from 710 at the end of 1920 to 220 in December, 1921. In those years the men were retained in employment by the manufacture of light alloy boats and light metal articles for domestic and industrial use, which, at the same time, extended the experience gained in the use of duralumin for light construction. In June, 1922, the building of commercial machines was again started under Allied control, and the "G 24" aircraft was completed, a three-engined machine designed to carry eleven passengers.

About this time Junkers' branch works in Moscow and at Limhamn, in Sweden, were founded. In Russia, among others, the "J 20"

NIGHT VIEW OF POWER HOUSE

and "J 21" designs were built. About 1926 the first single-engine machine, the "Ju 33/34," was constructed at Dessau, and the next year an important commercial machine, the "G 38," was built with a capacity for thirty-four passengers. About that time Professor Junkers used air-cooled Bristol engines in some of his machines, but he was pushing ahead, too, with the Junkers opposed-piston oil engine working on the compression-ignition principle. That engine was used for the 20-ton "G 38" design and for perhaps the first time there was, the beginning of the Junkers idea of unity of design throughout the construction of both hull structure and engines. In the years from 1926 to 1928 changes took place in the organisation and working of the civil air lines of Germany, and the section of the Junkers business which was concerned with the operation of aircraft was merged with the newly formed group, the German Lufthansa. For a year little advance was possible, and the business which from 1921 to 1925 had seen the kilometres flown increase from 350,000 to 4,801,462, the number of passengers carried rise from 2230 to 93,639, and the weight of goods carried increase from 2500 kilos. to 656,602 kilos., all in Junkers aircraft, stood still for a time until about the beginning of 1927, when a new start was made with the construction and operation of Junkers aircraft, not alone in Germany, but in countries abroad, particularly in South America. In this work much experience was gained in the operation of machines under tropical conditions, and over long, difficult routes. From 1930 to 1932 outstanding machines completed included the single and three-engined "J 52" types, designed to carry fifteen to seventeen passengers. In 1933 there followed the high-speed "Ju 60" and the "Ju 160." Extensions were made to the factory and the administration buildings, and the construction of commercial machines was continued and attention devoted to the adaptation of the commercial designs to the needs of service machines.

In 1936 the famous "Ju 86" was built, and in the following year the "Ju 90," a new monoplane of high carrying capacity with four engines, was constructed. The last three of these new types were provided with retractable undercarriages. It can be said that the outstanding performance of these aircraft gained for them a place in the commercial services of all parts of the world.

When, in 1935, the German Air Force was again revived, war-time construction proceeded apace. The firm first produced the "Ju 52" as a bomber, plans for the ready conversion of this machine having already been included in the original designs. The "Ju 86" was also a machine designed with a dual purpose, and in its "Ju 86K" form was a twin-engine bomber, powered with two 700 H.P. "Jumo" opposed-piston Junkers compression-ignition engines, or, alternatively, with two 945 H.P. B.M.W. nine-cylinder, radial, air-cooled engines. With either design of machinery a Junkers-Hamilton controllable-pitch airscrew was employed. These machines were produced up to the end of 1937, and works extensions and supply facilities were increased in order to allow the firm to supply these aircraft in even larger quantities to the German Air Force, and to certain foreign Governments.

In 1936 the original Junkers Flugzeugwerk A.G. took over the activities of the engine-building undertaking, the Junkers Motorenbau G.m.b.H., and both sides of the works were run under one company, which was styled the Junkers Flugzeug und Motorenwerke A.G., the share capital being increased to over £10,500,000.

We have previously referred to the work done on the opposed-piston compression-ignition engine. The first engine of this type was shown at the Berlin Aeronautical Exhibition of 1928. It was successfully flown in 1929, and thereafter was widely applied in machines for the Lufthansa services and abroad, and for use in the German Air Force. After 1936, when the aircraft and engine works were united, two new types of engines of the Junkers type, designed to utilise petrol fuel, were produced, as well as the oil engines. These were the "Jumo" 210 and 211, with cylinder capacities of 19·7 litres and 35 litres respectively. By 1938 new versions of these engines were completed in which the carburetter system was dispensed with and was replaced by a direct-ignition system for petrol. Many of these engines were installed in the later types of Junkers dive-bombers and other service machines.

Enough has been said to indicate the importance of the bombing of this particular target in our endeavour to reduce the supply of machines and equipment for the "Luftwaffe." The works is—or was—no doubt one of the finest of its kind in the world, and in it advanced systems of series manufacture had been perfected, while important sections carried on experimental and research work on aero-dynamical problems, hull and wing structures, and engine design.

Substitute Materials in Time of War*

By GEO. SCHLESINGER

THE following is a brief account of some of the investigations on substitute materials made at the Laboratory for Scientific Production Research in Charlottenburg during the Great War, 1915 to 1917.

The most important applications of substitute materials are those concerned with production processes, such as—

(1) Machine tools and their drives, for which we require cast iron, nickel steel, nickel chrome steel, belts for drives and non-ferrous alloys, which include copper, tin, zinc, white metals, and aluminium.

(2) Lubricants, for which we require either natural or artificial materials for the production of oil.

(3) Cutting tools, which involve the use of tungsten, cobalt, vanadium, and molybdenum.

(4) Coolants for which we require mineral oil, saponifiable oil and soda.

1. MACHINE TOOLS

Machine tools are the basis of any manufacturing process. The investigations carried out by the Research Department were chiefly concerned with substitutes for bearings made of scarce non-ferrous alloys, substitution for heavy machine tool beds, stands, uprights, &c., so that a saving in cast iron could be effected, and substitution of fabricated materials for leather belts.

Bearings.—To permit the safe and efficient operation of machine tools, the bearings must be made of reliable materials which will withstand the large forces caused by roughing cuts and the high speeds necessary for finishing cuts. Sometimes machines are called upon to withstand combinations of high speeds and heavy pressures, as, for example, in the roughing of steel shells of small diameters. Although these machines are continuously subjected to severe conditions night and day, the bearings are expected to function without seizure or other forms of failure. The components produced on these machines must conform to prescribed limits of accuracy, for interchangeability is essential in mass production. Faulty spindles frequently have a direct influence on the accuracy of the work piece, so that reliable bearings are indispensable.

The bearings of main spindles are made either as plain journals, using bronze or white metal, or as chrome steel ball or roller bearings.

At the time that these experiments were madel ball bearings were not extensively used in Continental machine tools, because the accuracy of commercia, ball bearings was below that required for first-class machine tools. The allowance for true running and for axial slip of the main spindle is about 0·0005in., and only special bearings, the manufacture and selection of which entails a considerable increase of price, were capable of fulfilling these requirements. Another disadvantage at that time was that both races and balls were manufactured of chrome steel having a specification such as 1 per cent. C, 1·5 per cent. Cr, 0·4 Mn, 0·3 Si, 0·26 Ni, which was difficult to supply owing to the scarcity of chrome and nickel.

As the plain bearings were simpler and could be run up to 500 r.p.m. for small and medium machines without danger, if the lubrication was good, the introduction of ball bearings as substitutes was almost dropped. The task of replacing copper alloys like brass and bronze for bearings and gears, wherever it was possible, in lathes, milling, drilling, and grinding machines, then became very urgent. The responsibility of introducing substitute materials, the reliability of which was not proved by actual years of service, was very great. It was resolved to make, without delay, running tests under actual working conditions, without wasting too much material. The machines were carefully checked while working under the extreme loads to which they were likely to be subjected while engaged on actual production.

The Production Research Department made the programme for these tests and completed the preliminary investigations in eight weeks. Standard headstocks were taken from machines engaged in actual production and changed for the trials. Leading machine tool makers were ordered to send headstocks of complete machines without changing the designs, but simply replacing bearings, bushings, gears, and nuts, generally made of phosphor bronze or brass, by substitute parts made of cast iron or war bronze, to the designs prescribed by the Research Department. Wherever this simple substitution proved successful, no further change in the design of the machine was undertaken. Six machines were tested. The duration of the tests was ten hours without any interruption. This corresponded to the actual running time which occurred during the eleven-hour shifts (two shifts per day), normally worked in armament factories at that time. The eleven-hour shift could not be exceeded, for one hour's rest in every twelve was found to be essential for the safe working of these machines.

The following combinations of materials for main spindles and bearings respectively were investigated :

(1) Hardened main spindle on (*a*) cast iron bushing, (*b*) zinc-bronze (war bronze), (*c*) hardened steel.

(2) Unhardened work spindles of hard steel on (*a*) cast iron, (*b*) zinc bronze, (*c*) hardened steel.

Permissible rubbing speeds between spindle and bearing had to be adapted to suit spindle speeds between 20 and 8000 r.p.m. To-day, using well-lubricated high-speed bearings, the following speeds and pressures are permissible :—

Velocity in feet per second of rubbing surfaces ...	20	30	40	60	75
Permissible pressure in pounds per square inch...	165	190	205	225	230

The chemical composition of :—

(1) A good bronze was generally 90 Cu, 10 Sn.
(2) A good brass 82 Cu., 8 Sn., 7 Zn., 3 Pb.

The war bronzes were zinc bronzes of the chemical analysis :—

Zinc (Zn.)	94 to 88 per cent.
Copper (Cu.)	2 to 8 per cent.
Aluminium (Al.)	3 per cent. (average)
Lead (Pb.)	1·5 to 1 per cent.
Iron (Fe.)	0·1 to 0·15 per cent.

Of much greater importance was a cast iron alloy with the analysis—3·6 C, 2·16 Si, 0·29 Mn, 0·027 S, 0·07 P. The cast iron alloy was well annealed to make it soft, but it had a dense surface and a high tensile strength of 16 tons per square inch.

As milling machines present the most unfavourable working conditions for substitute bearings, these

* The Institution of Production Engineers. Advance publication in the *Journal* of the Institution, July, 1940. Abstract.

machines were tested first. With the exception of the front bearings, this good cast iron proved an exceedingly satisfactory substitute material.

The following table shows the specific pressures exerted during the tests on the front and rear bearings of the main spindle. The pressure on the front bearing (downward) varied between 28 lb. and 570 lb. per square inch, while that on the rear bearing (upward) varied between 14 lb. and 180 lb. per square inch. The bearing surfaces at the front and rear bearings were 12·5 and 8·8 square inches respectively, excluding oil grooves.

Dial reading of steel belt dynamometer No.	Actual load on front bearing No. 1.	Bearing pressure on front bearing.	Actual load on rear bearing No. 2.	Bearing pressure on rear bearing.
	Lb.	Lb./sq. in.	Lb.	Lb./sq. in.
0	360	29	118	13·5
1	870	70	122	14
2	1450	116	240	27·4
3	2050	163	355	40
4	2600	208	495	56
5	3200	255	615	70
6	3800	303	770	87
7	4300	345	910	103
8	4900	392	1050	119
9	5500	440	1200	136
10	6000	480	1330	150
11	6600	530	1460	165
12	7150	570	1600	182
	Pressure on the front edge		No unilateral increased pressure	

These tests revealed conclusively that seizure in the front bearing was likely to occur before failure elsewhere. As a result it was decided not to use substitute materials for the front bearings, but to retain here good phosphor-bronze bearings. In all other places, where conditions were not so severe the substitute materials recommended and used in the tests were adopted in the standard machines.

The tests also show that it is necessary to harden the bearing section of the main spindle, but that in other cases hardening was not necessary, provided a steel of 170 to 180 Brinell was used in conjunction with cast iron or zinc-bronze bushings.

Further tests showed that hard cast iron bushes (2·3 Mn, 1·2 Si) were entirely unsatisfactory.

Steel which is not hardened runs well on soft cast iron provided correct lubrication is effected. This substitution is particularly suitable in the case of auxiliary shafts.

The use of drop lubricators with feed glasses is satisfactory provided the capacity of the lubricator is sufficiently large. In many cases where these substitute bushes are introduced, it is desirable to increase the size of the lubricator.

Tests were also conducted with hardened steel spindles in hardened steel bushings, particular attention being paid to spindles of small diameter up to about 1¼in. The results were not encouraging, for seizure occurred at rubbing speeds of 13ft. to 16ft. per second, when the bearing pressure was 40 lb. per square inch. Better results may be obtained if special steel and appropriate hardening (nitriding) processes are used. Care must be taken that there are no oil grooves parallel to the axis of rotation or in positions subject to direct loading. In addition, the lubricant should, if possible, be introduced into the bearing at the point of minimum pressure. The edges of all oil grooves should be well rounded.

Machine Bases, Beds, and Stands.—The bases of machine tools must be heavy and rigid to withstand the large cutting and driving forces, which tend to set up undesirable vibrations. Where it is possible to replace these heavy machine parts by concrete, a considerable saving of cast iron can be effected.

In 1917 and 1918 an attempt was made to replace the cast iron beds of lathes and capstan lathes by solid reinforced concrete beds having g iding and bearing surfaces of fine hard cement. The result was a complete failure. The ways acted as a grindstone against the carriage and the fine dust which was worn from the cement combined with oil to form an abrasive paste which quickly ruined both beds and carriages.

Although concrete is not satisfactory for bases that include guiding and bearing surfaces, it is useful as a substitute material for heavy machine bases which have no wearing surfaces.

The sharp edges of box stands should not be subjected to rough handling and heavy impacts, and, where possible, it is advisable to have well-rounded corners. Where this is not practicable a sheet iron case filled with concrete constitutes an effective method of protection.

The damping capacity and natural frequencies of solid concrete stands were compared with those of corresponding hollow cast iron bases. The comparison was quite favourable for the case of a slender pyramidal stand. The natural frequency of the concrete base was 62 oscillations per second, compared with 52 per second for cast iron. The amplitude of oscillation of the concrete was half that of the cast iron and the damping capacity 2·4 times that of the cast iron. For box stands the comparison is even more favourable.

Most engineers disapprove of the introduction of concrete and similar brittle materials into the workshop, but when adequate supplies of iron are not available these substitute materials can be used to advantage.

Belting.—It seems to be out of date to discuss the necessity of replacing leather belts by a war substitute, as the single drive is progressing and the direct coupling of the electric motor with the machine tool saves belts. But going through the country and studying existing machine shops, one finds even to-day that only a few very well-equipped manufacturing shops run on electric drives only. The great majority have a mixed drive, using the transmission line for the machines of similar kind and size, and reserving the individual drive for those, which are most modern and are used for special purposes and work frequently in night shifts.

It was found that the average practice in British workshops was to have approximately 30 per cent. of machines in a given shop with individual drives, the remaining 70 per cent. of the machines in that shop being driven from the line shaft. In the years 1914 to 1918 the relation was 10 per cent. to 90 per cent.

Leather suitable for belts can only be obtained from the strongest hide of sound oxen and as the quantity of cattle available for this purpose in an industrial country is not usually sufficient to cover the need it is necessary to consider the introduction of substitute belt materials.

During the Great War, therefore, belts were designed of wire, paper, cotton, pulp, in the most varied combinations and some thousands of workmen were producing these belt substitutes. As a result of research it was possible to evolve belt fabrics having an efficiency only 10 per cent. less than that of ordinary leather belts. The only remaining disadvantage of such fabrics is that their life is considerably shorter than that of leather. It is interesting to note that six months after the war none of these artificial belt factories existed. The good qualities of leather belts are so overwhelming that substitute fabrics were quickly abandoned as soon as adequate supplies of leather became available. Nevertheless, these fabrics were of great value during the emergency.

2. Lubricants

Lubrication is a vital factor in the performance of any bearing. In peace time the necessary oil supplies are readily obtainable from natural sources such as exist in Russia and America, but in time of war countries with inadequate natural sources of oil supply must depend to some extent on substitute oils. Only those substitute lubricants which are pure and have a good load-carrying capacity can be effectively used in bearings and for gears.

In order to obtain a suitable lubricant the research department tested five different oils :—

(1) R.M.O. (Russian machine oil).
(2) V.I. (Voltol, sliding oil i).
(3) V.II. (Voltol, sliding oil ii).
(4) K.I. (compound oil i).
(5) K.II. (compound oil ii).

The research department had to decide (1) whether the R.M.O., which was the machine oil in most general use, was the most suitable lubricant, or whether by the introduction of another oil it was possible to effect a sufficient saving in power consumption to justify the change ; (2) whether the Engler, S.A.E. and Redwood viscosity numbers, together with other data obtainable by existing methods of oil testing, gave reliable indications of the suitability of an oil for use in the workshop ; (3) whether the new methods devised by the research department for oil testing gave reliable results and within what limits these results indicated the suitability of an oil for use in the workshop.

As the different existing oil testing machines did not give reliable indications of the load-carrying capacity of lubricants, an ordinary headstock with a single driving pulley was used for testing war oils. The headstock had eight speeds and the working load could be easily adjusted from zero, when running idle to full load and overload, by a brake drum. Knowing the viscosity of the oil used and the temperatures of the bearings, the efficiency of the machine was changed by changing the lubricant. The results observed included duration of tests, temperature of air, temperature of oil at frequent intervals throughout the test, and power consumptions for the various loads and speeds between 9·25 and 338 r.p.m. The conclusions upon which the suitability of an oil was based were (1) temperature of the oil and the machine ; (2) efficiency of the machine for given loads ; (3) quantity of oil consumed in pounds per unit of work done (kWh). The viscosities of the various oils tested were as follows :—

Engler Viscosity

Oil symbol.	At 50 deg. Cent.	At 30 deg. Cent.
R.M.O.	6·75	20·1
V.I	7·82	18·4
V.II	6·82	14·9
K.I	7·13	21·4
K.II	3·86	9·69

The tests, which generally lasted five hours, enabled the research department to classify the oils in order of efficiency. V.I (Voltol, sliding oil i) gave the highest efficiency, V.II, K.I, K.II and R.M.O. having lower efficiencies, in that order. It was surprising to note that the best oil effected a saving in consumption of 25 to 30 per cent. for idle running, and 10 to 15 per cent. for the loaded machine. As a result of these tests it was possible to compound a so-called "unity oil" which was used during the Great War with good results.

It was evident from the foregoing experiments that the load-carrying capacity of oil was one of the most decisive factors influencing its utility in the workshop. Without such experiments it is necessary to know the relation between load-carrying capacity and viscosity if the best oil for a given purpose is to be selected.

The power bill for a machine shop may not be the most important item of expenditure, but savings of 10 to 15 per cent. for loaded machines and up to 30 per cent. for the unavoidable idle running machin s are by no means negligible. Such savings have a favourable effect upon the conservation of the coal supply of the country.

3. Cutting Tools

During the last war the main components of high-speed cutting tools were tungsten and cobalt. To avoid the difficulty of forging these alloys the tools were usually made straight and solid and ground from the solid. The following table indicates the usual compositions of the high-speed tools used at that time.

	C.	Cr.	Tu.	Co.	Va.	P/S.
(1) High-speed steel for ordinary work	0·55 to 0·7	3 to 4·5	12 to 14	—	—	0·03
(2) High-speed steel of good efficiency ..	0·55 to 0·7	3·5 to 4·5	16 to 18	5	—	0·03

The percentage of tungsten varied between 12 and 18 per cent., that of cobalt between 0 and 5 per cent. Both metals had to be imported and were very scarce and expensive, but both were indispensable for high-speed tools, as attempts to replace tungsten by molybdenum failed at that time. In an attempt to overcome the difficulties of restricted supplies the solid high-speed tools were cut to form tips which were brazed to ordinary tool steel shanks. The advantage that accrued from this procedure was only small, for the life of the tungsten available was not increased. Cemented carbides did not exist at that time.

4. Cutting Oils

Although cutting oils are not so important as lubricating oils, they are nevertheless required in large quantities to facilitate machining processes. One advantage of the use of cutting oils is that it considerably increases the life of high-speed tools. When such oils are introduced to machines where they have not previously been used, changes of design are frequently necessary. These changes involve the inclusion of pumps, pipes, tanks and trays for the storage, application and recovery of the oil during use.

Good cutting oils are composed of mixtures of mineral oil with sulphurised fatty oil. A typical analysis is 20 per cent. saponifiable oil, 1·8 per cent. total sulphur and remainder mineral oil. The thinning relation of water to oil varies between 20 to 1 and 50 to 1.

The task of the research department at the time the tests on cutting oils were made did not include the investigation of such factors as freedom from dermatitis and cancer effects, absence of unpleasant odours, freedom from corrosive agents, freedom from effects on machine lubricating oil, freedom from gumming and oxidation, freedom from firing at working temperatures, and freedom from separation of the constituents at working or storeroom temperatures. The factors that were investigated appertained to production only and included (*a*) cooling of the tool with consequent increase in life ; (*b*) lubrication of the tool, which reduces wear and saves regrinding and resetting; (*c*) protection of the machine by the removal of swarf and dust ; (*d*) cooling of the work piece, thus ensuring good finish and accurate dimensions.

For the tests on cutting oils the drilling machine was chosen, for the following reasons :—(1) It is comparatively easy in drilling tests to keep all factors constant except the desired variable, in this case the cutting oil ; (2) it is for drilling machines that cutting oil is most frequently used in the workshop ; (3) equipment for efficiency tests on drills was readily available.

The effectiveness of the cutting oils was judged by the number of holes of equal size which could be drilled under identical circumstances before the drill was dulled. The results were as follows :—

(1) Dry tests without lubricants. Cutting edge became so hot that after very few bores, sometimes after one bore, the tool was destroyed. These tests were soon stopped.

(2) Test with pure water. Tool life was very long, the efficiency excellent, but the machine was rusty in a very short time. The use of water as a coolant was rejected.

(3) Soda water tests with neutral 10 per cent. soda gave a somewhat smaller efficiency than tests with pure water, but the undesirable rusting effects were eliminated. This coolant was considered quite suitable.

(4) Tests with cutting oils in which the standard oils used in peace time were thinned by water in proportions 10 to 1, 20 to 1, 50 to 1, gave an efficiency less than that when soda water was used. When cutting oil was used the power consumption of the machine was less than when the other coolants

were employed. This is due to the fact that oil has a greater lubricating capacity than the other coolants. The use of oil has other advantages, for it is much easier to obtain a pure reliable oil than to get pure soda which does not affect the machine or the skin of the operator. In addition, cutting oil facilitates the production of well-finished surfaces and is particularly suitable for tapping and threading, during which operations it affords better protection for the delicate tool edges than pure water or soda water.

A Bleaching Plant in British Columbia

As in other parts of Canada, the war is directly responsible for a quickening of activities in the British Columbia pulp and paper industry. At Woodfibre, in Howe Sound, 30 miles from Vancouver, the B.C. Pulp and Paper Company has turned its attention to the production of bleaching pulp on a large scale. Much new equipment has been installed in the old plant and methods of operation have now reached a point where the plant may well be described as a laboratory built on a commercial scale.

Water for this plant is drawn from glacier-fed lakes, containing a minimum of organic and inorganic materials, and enters the mill at a pressure of 400 lb. per square inch. It is distributed to a number of Pelton turbines to generate a part of the power requirements of the mill before it becomes process water. About 17,000,000 gallons of water are used daily, all of which passes through sand and gravel pressure filters. The interior filter piping was treated to guard against contamination with iron, and all piping leading to and from the filters is continuous wood stave pipe. No chemical treatment is given for boiler feed or process water.

The unbleached department of the mill was remodelled two years ago, and a chemi-pulp hot acid accumulator has been added. All digesters are well equipped with instruments, flow meters, or automatic control. The digesters and acid accumulator are equipped with chrome-nickel steel strainers, relief piping, pumps, and valves, designed to ensure steady operation. Instead of "blowing" the digesters under pressure, the digester pressure is relieved at zero and the liquor drained off through a perforated coil, located in the bottom cone. Water is then added and the pulp given a wash in the digester before it is "dumped." The intention here is to ensure a better strength, and give a thoroughly washed pulp to the bleaching plant.

Concrete has been used throughout the entire structure, both in the building proper and in the numerous bleaching cells and storage tanks. All surfaces to which pulp is to be exposed, as well as all storage tanks, are tile lined. The building is designed to eliminate dirt, provide excellent lighting on a 24-hour basis, and ample ventilation. The structure is 122ft. by 64ft. by 55ft. The bleach liquor make-up and storage tank equipment, as well as the electrical distribution of the control room, are in the building. Filtered air is introduced at the ceiling, with an exhaust fan situated in the basement. This air is thermostatically controlled. The whole building is windowless.

Lime storage, caustic storage, and lime-mixing tanks are situated in a separate building, materials being transferred to the bleach plant by centrifugal pumps. The batch principle is used, with the bleaching cells all of the vertical type and arranged for a three-stage operation on paper pulp, and a four-stage operation on dissolving pulp, with pH control between stages as well as after the final washing.

Liquid chlorine is transferred from 30-ton tank cars to a scale drum, and after passing through the evaporator is brought to the bottom of the chlorinators through "Pyrex" glass pipes. The pulp is washed on a rubber-covered Oliver filter and transferred to the first-stage hypochlorite bleaching cells on a belt conveyor. After bleaching the pulp is emptied into a solution chest directly below. This chest is equipped with a rubber-covered, propeller-type agitator, and from here the pulp is pumped to the second washer thickener which feeds either the alkali refining stage or the final hypochlorite stage, depending on the type of pulp to be made. In general, rubber is used extensively for lining operating equipment and machinery.

The pump is washed in four low-density vacuum washers, operating without press rolls, and three washer thickeners for high density, equipped with two press rolls each. They operate either in tile-lined concrete vats or rubber-lined iron vats. Warm water is added to the cake of pulp between the press rolls.

Specially designed head-boxes, with propeller agitators, ensure good mixing and efficient washing. Everything about the head-boxes, including equipment, is made of chrome-nickel steel. Lead pipes and rubber-lined valves handle bleach liquor. All valves throughout the entire plant, with the exception of lubricated plug cocks used in the bleach liquor make-up system, are of the solenoid-controlled, hydraulically operated type. Individual motor drives and reduction gears are used throughout the bleach plant to operate the various machines, motors ranging in size from 3 to 250 H.P.

The demand for white water being intermittent, storage tanks have been erected on the roof of the bleaching plant. The electric current is distributed from one centrally located room. Each machine is equipped with its own control panel, on which are mounted push-buttons for motors, switches for solenoids, pressure gauges, level gauges, vacuum gauges, temperature recorders, and hand-control equipment. A number of individually mounted flow meters are conveniently located to gauge the quantity of fresh and white water used in the various operations.

After the final washing, the pulp is rescreened and riffled. Forty-two twelve-plate flat screens arranged in rows of three, equipped with fine-cut, chromium-plated screen plates, are used. After passing over felt-covered rifflers, the pulp is thickened and delivered to the two large blending and storage tanks. The drying equipment consists of two Fourdrinier machines with variable-speed drives.

The first installation of Flakt driers in Canada was made at this mill. In these, the pulp does not contact the hot drying elements, but passes between rows of heating coils, and the moisture is removed in a current of warm air. The object is to produce a sheet that breaks up readily in the beaters with no loss of strength and colour.

"Going To It"

We have received the following helpful communication from Mr. F. J. Pascoe, a director of British Timken, Ltd., Birmingham:—

It may help others to achieve the highest war output if I set out some measures taken to maintain fitness and cheerfulness among our workers who are "Going To It" with a will.

These hints may be valuable as our welfare ideas are based on years of experiments and are not a product of present emergency conditions.

The black-out, the seven-day week and night shifts deprive workers of sunlight. We give artificial sunlight treatment. While the Timken works is large and elaborate arrangements are justified, suitable equipment is obtainable comparatively cheaply for the smaller works, but treatment must be regular and carried out under qualified supervision and in accordance with carefully prepared plans. We have a doctor in frequent attendance, the treatment being administered by a qualified nurse. We find that this treatment is definitely beneficial to the workers.

Short-wave therapy apparatus is used for treating septic wounds and skin troubles met with in industry. This apparatus may prove somewhat costly for a small works, but it is astonishing the beneficial results obtained in a relatively short time. Here again, treatment should be given under medical supervision.

Eyesight is of vital importance in quick and accurate production. We allow free eyesight tests by our visiting doctor. It does not cost us much and it is a help to the workers. Whenever workers complain of headaches the eyes should be tested.

Footwear is a problem. A girl worker, wherever she is, likes to look nice, but standing most of the day on concrete floors in thin high-heeled shoes will take very serious toll of her staying power. This is a most neglected point. Workers' footwear should be stout and in good repair. Rubber soles, except in certain types of factories, should be prohibited. We purchase wooden shoes (sabots), which we allow the girls to buy at half their cost to us. We consider the subsidy well worth while.

Smoking we allow. Some works cannot do this, but where it is permissible it does help. We have one very strict rule—no smoking for half-an-hour before people knock off. The reason for this is that fires caused by cigarette ends nearly always show within that time.

Music in working hours is a benefit of which we probably have as long experience as anyone. Our ideas have come down to these: broadcasts of records in two sessions each day to quiet shops where work is of a monotonous nature. We keep to one class of music in each session—waltzes or marches. Mixing them upsets rhythm. Never broadcast vocal records. At mealtimes we broadcast light classical music. In A.R.P. shelters we put over stirring choruses. Complete music relaying equipment is easily purchased.

Works' canteens are sometimes dingy. Why should they be? Paint is cheap and pleasing decorative ideas are even cheaper. A woman's ideas will soon brighten the canteen. Preparation and choice of food for the workers should be as carefully planned as the production in the factory.

The many outstanding features and facilities afforded to our workpeople are a direct reflection of the personal interest of our chairman, Mr. Michael Dewar, himself an active member of the Industrial Welfare Society.

In the national interests we extend to any director or works manager who may read your paper and who is engaged on war production an invitation to see our welfare methods at first hand and discuss them with us.

Sixty Years Ago

The British Association at Swansea

In 1880 the British Association held its annual meeting at Swansea. The public accommodation of that town is to-day of a very high standard, but sixty years ago it was far otherwise. From the reports of the meeting published in our issues of August 20th, 1880, and of subsequent dates it is to be gathered that neither the place of meeting nor the proceedings at it made a favourable impression on our representative. He described Swansea as a town in which an enthusiastic engineer would feel particularly happy and a Ruskinite of any description particularly uncomfortable. The room used by the Association for its receptions was a partly temporary, partly permanent shed in a yard at the back of the Agricultural Hall. The soirées were held in the Pavilion, a gigantic wooden shed close to Swansea Bay and the various sections met in schoolrooms or chapels. Altogether, so our reporter wrote, the public building accommodation of Swansea was less extensive and less elegant than in any town which the Association had visited for some years past. Those attending the British Association meetings, our representative remarked, were conventionally supposed to be desperately in earnest to spread the knowledge of science, but in that respect there was a good deal of organised hypocrisy and in good weather the meetings largely became reduced to the level of "the learned societies of London out for a holiday." The President of the Swansea meeting was Dr. A. C. Ramsay, Director-General of the Geological Survey. Dealing with his address, we described it as one which was calculated to interest no one except geologists. Nevertheless, reading the lengthy abstract of it which we reprinted, we may now feel that it was not of such specialised interest as it perhaps seemed at the time. In spite of the views and doctrines which gradually crystallised out of the work of Hutton, Playfair, Lyall, William Smith, Murchison and other celebrated geologists, many people still disbelieved in the principle called "uniformity of action"—that is to say, that the forces which shaped the world in the course of its geological history were identical with those which we see in action around us to-day. Even among geologists there still existed relics of the theories advocated by Werner and others that the physical phenomena which produced the older strata were different both in kind and degree from those which now rule the world. It was held for instance, in some quarters, that the primitive crystalline rocks had been formed by the action of oceans at high temperatures, that mountain ranges had been thrown up suddenly in great cataclysms, and that volcanic eruptions in former ages had been of a magnitude with which those of modern times were comparatively insignificant. It was Professor Ramsay's object to dispose of these views once and for all by advance detailed evidence in favour of the doctrine of uniformity. There were still many people who held that geology was inconsistent with the truths of revealed religion. Their argument was based largely on the almost interminable periods of time which geologists postulated for the formation of the earth's strata. Professor Ramsay's address must have brought conviction to many who were beginning to doubt the literal significance of those passages of the Book of Genesis which describe the formation of the earth and on which certain historians had based an estimate of the age of the earth, an age of a few thousand years.

BOOKS RECEIVED

General Physics for Students of Science. By R. B. Lindsay. London: Chapman and Hall, Ltd., 11, Henrietta Street, W.C.2. Price 22s. 6d. net.

1001 *Mechanical Facts Made Easy.* Edited by P. Marshall. London: Percival Marshall and Co., Ltd., 60, Kingsway, W.C.2. Price 3s. 6d. net.

A New Dictionary of Chemistry. Edited by S. Miall, LL.D., B.Sc. London: Longmans, Green and Co., Ltd., 39, Paternoster Row, E.C.4. Price 42s.

Construction Estimates and Costs. By H. E. Pulver, B.Sc. London: McGraw-Hill Publishing Company, Ltd., Aldwych House, W.C.2. Price 33s. net.

Aircraft Blueprint Reading. By H. V. Almon, B.Sc., and R. K. Mead. London: Sir Isaac Pitman and Sons, Ltd., Parker Street, W.C.2. Price 6s. net.

Mechanism and the Kinematics of Machines. By W. Steeds, B.Sc. London: Longmans, Green and Co., Ltd., 39, Paternoster Row, E.C.4. Price 18s. net.

Steel Manufacture Simply Explained. By E. N. Simons and E. Gregory, Ph.D. London: Sir Isaac Pitman and Sons, Ltd., Parker Street, W.C.2. Price 6s. net.

The Metallurgy of Deep Drawing and Pressing. By J. Dudley Jevons, Ph.D., B.Sc. London: Chapman and Hall, Ltd., 11, Henrietta Street, W.C.2. Price 50s. net.

Properties of Ordinary Water Substance. By N. E. Dorsey. New York: Reinhold Publishing Corp.; London: Chapman and Hall, Ltd., 11, Henrietta Street, W.C.2. Price 90s. net.

Alloys of Iron and Chromium. Vol. 2, *High-Chromium Alloys.* By A. B. Kinzel and R. Franks. London: McGraw-Hill Publishing Company, Ltd., Aldwych House, W.C.2. Price 40s. net.

The Engineer

AUGUST 30, 1940

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EIGHT-PAGE SUPPLEMENT—"THE METALLURGIST"

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The Metallurgist

THE AUGUST NUMBER OF
THE METALLURGICAL SUPPLEMENT TO
"THE ENGINEER" ACCOMPANIES THIS ISSUE.

HANDSOME IS AS HANDSOME DOES

MODERN methods of finishing the surfaces of materials give the lie to the old tradition that good finish meant good workmanship. Nowadays, it means nothing of the kind. One has only to consider the accessories of motor-cars to recognise that there is no relationship whatever between surface finish and quality of material and workmanship. There was a good deal of substance in the forgotten tradition. It was held in engineering as in other trades that the craftsman who took a pride in a fine exterior was certain to take equal care with what was hidden from the eye. He had a standard of thoroughness to live up to, and like the Othello who blacked himself all over to get into his part gave as much care to things unseen as to those subject to touch or sight. Furthermore, polish on metals was in a measure a test of their quality. The better the steel the more mirror-like the surface that could be put on it. All the elbow grease and emery paper in the world would never make poor metals look other than they were. The science of metallurgy has changed all that. The quality of metals is settled long before they reach the hands of the fitter and turner. True, skinning may occasionally reveal a "ghost" and every casting is not sound; but take it for all in all no one would think of judging the quality of metals by their surface appearance, just as no one would attempt to evaluate accuracy of fit by the loving care taken on finishing a surface. Finish is, in fact, no more than a marketable quality; it is not essential to the working of a machine. That is not to say that it is never worth while. There are times when it is well worth its cost; but there are others when it is not, and the most obvious of those times is war.

Under war conditions any refinement or workmanship which is not essential to the operation of the machine or product must be regarded as wasted. That does not apply to surface finish only, but to the machining of parts which do not affect the accurate working of the whole. It may be extended, too, to cover materials. Where a lower class material is just good enough for its destined use it is wasteful to use a higher class material. Indeed, it is often justifiable to lower the factor of safety in view of the lessened "expectation of life." All this should be obvious, but its unorthodoxy is offensive to a great many persons, particularly, we fancy, in the Services. Everyone has heard well-substantiated tales of Service inspectors who have rejected parts because they were defective in some minor degree, or were out by a fraction in unessential dimensions. It is exceedingly difficult to break down a traditional practice of this kind, and Mr. Morrison, the Minister of Supply, is to be congratulated on the success he has already attained in this direction. He must have had an uphill task, and only by the exercise of great firmness tempered by tact can he have won the consent and co-operation of makers and of the Services which they supply to changes which must be distasteful to them. He has already cut down or cut out unnecessary operations, reduced the severity of inspection, and caused parts to be redesigned so that less work on them is needed and the rate of output is increased. That is something to be proud of, but no doubt much remains to be done, much that will offend the tradition of engineers and bring a vicarious blush to the cheeks of the users of their products. A bold policy is called for whatever heartburnings it may cause. In war there is only one measure of value. Is it essential to the efficient operation of the product? If it is not, then it should be ruthlessly extirpated. This is no time for frills and pretty-pretty. We cannot afford to waste labour on polishing where polish is unnecessary, or on detail finishing where nothing is gained by it. Nor can we afford to use the best of materials where the second best will do what has to be done.

We know how hateful this policy will be to a great many engineers; we know that they will charge us with trying to undermine the excellence of output which has ever been their pride. We must therefore make our meaning as plain as plain can be. In supporting the Minister of Supply we are not advocating the doing of anything that will lower in the slightest degree the effectiveness of the product for its intended purpose. Nothing could be further from our intention. To keep our war products at the highest present efficiency and to advance them beyond it in the immediate future must be the object of all engineers. But what Mr. Morrison is doing is to cause a review to be made of munitions and implements of war to discover if any waste labour is being put into them and to consider if time and material cannot be saved. He has said that in the case of the Brenn gun certain recent modifications will enable the rate of output to be increased by 20 per cent., and we have it on the testimony of the original maker of the gun, that the new designs are better than the old. That is, we suggest, a typical case. There is no reason at all why simpler designs than those current at the opening of the war, or designs which lend themselves to easier machining operations, should not be at least as good. That is, we suspect, true also of materials. Many of our war machines are built to last a lifetime. A shorter view might in some cases be taken with advantage. The expectation of life of a great many of the machines can be no more than a few months, and we trust that none, or few of of them, will be wanted three years hence. There are occasions when that fact might be taken into account with advantage—for example, in bearings and rubbing surfaces and in parts subject to corrosion. Obviously, in such a matter it is quite impossible to generalise, but it is suggested that we might in this matter take a leaf from the Americans, who deliberately build, when circumstances permit, for a short life, because they are convinced that later developments will soon put the machines out of date.

Concrete for Cast Iron

ONE of the troubles that Germany has brought upon herself by the expulsion of scientists from her midst is that their knowledge is being used against her. There are many scientific refugees in this country and by a wise disposition some of those who can be of value are being employed here. These men have brought to us not only minds trained in research in many different subjects, but in not a few instances actual records of work they had carried out in their native land. We benefit from this in two ways. First by learning at the source what Germany has been doing for several years past, and, secondly, by the fact that we can select from the information thus revealed anything that may be of value to us for our own use. Profiting by this knowledge we may be able to cancel or embarrass the lines of development which Germany was pursuing, to prepare in advance counter-activities to those which she may be expected to display, and, finally, to add to her difficulties by withholding from her materials which, unsuspected by us, were valuable to her as substitutes or for the preparation of *ersatz* products.

Amongst scientific exiles from Germany who came to this country several years before the war started is Dr. George Schlesinger, who is now the Director of Research of the Institution of Production Engineers. During two years of the last war Dr. Schlesinger was engaged in investigations on substitute material in the Laboratory for Scientific Production Research in Charlottenburg. In a paper prepared for the Institution and reprinted in part in our pages to-day, he has made public the results of several of these inquiries. Whilst it cannot honestly be said that they add much to our knowledge, they, at any rate, help to co-ordinate it. Much has happened in the quarter of a century that has elapsed since the German investigations were carried out. New materials have come into use, new methods of applying old materials have been evolved, and in certain subjects with which he deals—lubrication, for example—research has advanced our knowledge far beyond that of 1915–17. Hence whilst we do not deny the interest of the researches which he retails, we are rather doubtful that they will be of material assistance to mechanical engineers at the present time. Nevertheless, one at least will bear further examination. We refer to the short section which Dr. Schlesinger devotes to the use of concrete as a substitute for cast iron in machine tools. It is of interest because of the need to economise iron, but it must be recognised that the investigation carried out in Germany twenty-three years ago was neither very novel nor illuminating. We cannot feel surprise that concrete on concrete failed as rubbing surfaces, and everyone was well aware, long years ago, that mass concrete could be advantageously used as the bed of machines. There is no hint of a scientific use in Germany of concrete as a substitute for cast iron by the development of new designs and new methods of construction; nothing that was equal in merit, for example, even with the concrete ship. And unless concrete can be used as a genuine substitute and not as little more than a makeshift in a few selected cases, it cannot be regarded as a serious rival of cast iron in machine construction. If it is really worth while doing anything in this direction it will have to be done partly by a complete reorientation of our concepts of machine design and partly by an extended examination of the possibility of combining concrete and metals in the fabric of machines. Despite a few superficial

resemblances, cast iron and concrete are very different in their properties, and it follows that a design appropriate for one of the materials is unsuitable for the other. For example, the specific gravity of concrete is approximately no more than one-third that of cast iron, whilst its tensile strength is negligible. Hence, when equal weight is essential—to provide the "anvil" effect, let us say—three times as much material must be employed, and when tensile stresses have to be met, armouring is essential. Again, prolonged experience could alone show if concrete would stand up indefinitely, as cast iron does, to the persistent high-frequency vibrations which are generated by cutting tools.

If economy of cast iron is essential, we suggest that a more fruitful line of inquiry might be found in the design of machines. The fact is that cast iron has always been the cheapest material of the mechanical engineer, and he has, in consequence, used it recklessly. If cast iron were as costly as gunmetal, attention would have been paid to scientific design, and many parts which are now left solid would be cored out, so that the metal would only be placed where it was required to meet known stresses. Engineers then would not vaunt "massive" designs, but designs in which the material was used as effectively as possible. As long as cast iron was plentiful, it was uneconomical to be efficient in that way. It would have cost far more to core out holes and spaces in pedestals and base plates than the value of the iron saved. Moreover, there is a great deal to be said in favour of the smooth, clean, and uninterrupted outline which is a familiar feature of modern machine tools, and, finally, in many cases the solid walls give support and protection to gear or provide cupboards for tools and equipment. Nevertheless if the time is coming when economy in the use of cast iron will be essential, then, we suggest, that more is likely to be achieved by scientific modification of design and the surrender of certain traditional qualities, however desirable they seem, than—save in rare and rather gross instances—the substitution of iron by cement and sand.

Obituary

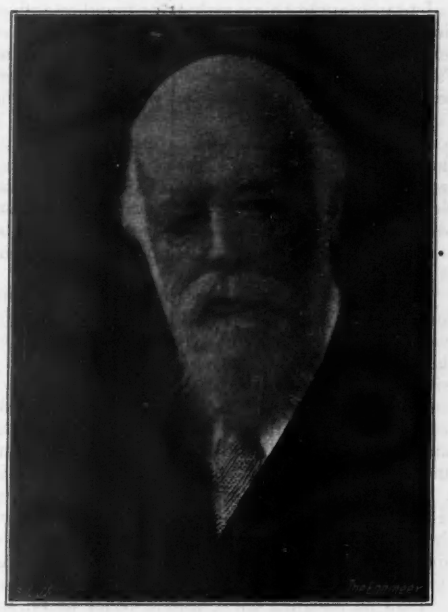
SIR OLIVER LODGE

At the age of eighty-nine Sir Oliver Lodge died on August 22nd at his home in Amesbury, Wiltshire.

Oliver Joseph Lodge was born at Penkhull, near Stoke-on-Trent, on June 12th, 1851. In his parentage may readily be traced many of the characteristics which he embodied in later life. Both his grandfathers were clergymen and schoolmasters. His paternal grandfather, the Rev. Oliver Lodge, was an Irishman, and came of a family renowned for their stature and strength. He had a family of twenty-five, of whom the twenty-third, also named Oliver Lodge, married Grace, the daughter of Joseph Heath, headmaster of Lucton School. The art of exposition, whether from the pulpit or from the schoolmaster's desk, was thus inborn in Oliver Joseph Lodge, the eldest of the seven sons of this marriage. Science, too, was his inheritance. One of his father's brothers was Mathematical Master at Lucton School and later became a London actuary. Another, after following a seafaring life, established a reputation in connection with the salvage of sunken ships. A third was a medical practitioner in London. His father began his career as an apprentice to his medical brother, but soon drifted into business in London, and, becoming interested in railways, was sent down to Trentham as an assistant cashier on the then newly constructed North Staffordshire Railway. Some time after his marriage and the birth of his eldest son, he left the employment of the railway and set himself up in business as an agent for the sale of blue clay in the Potteries. With his devoted wife as his bookkeeper and with his own great energy and thoroughness he prospered in his business and added to it agencies for other materials used in the district.

Oliver Joseph, in common with his brothers, was on occasion pressed into service in his father's office when the clerical work became too much for his mother to handle by herself. His father looked forward to the day when he would be able to take his eldest son into partnership. In preparation for his future career he was sent in the autumn of 1859 at the age of eight as a boarder to Newport Grammar School in Shropshire, an old-fashioned establishment at which an uncle by marriage was one of the three masters. His schooldays formed one of the most miserable parts of his life. Chief attention was devoted to Latin grammar, the rules of which were enforced with liberal doses of the cane. Young Oliver showed no aptitude towards a classical education; the only subject in which he took an interest was the chapter in the geography book which dealt with the shape of the earth, the phases of the moon, latitude and longitude, and so forth.

At the age of twelve he left Newport Grammar School and continued his education at a country rectory—Combs, in Suffolk—which had been given to his uncle, the Newport schoolmaster. His interest in astronomy had meanwhile been aroused to a pitch of enthusiasm by one of his aunts with whom he had spent a month's holiday, but at Combs he was once again condemned to study the classics. At the age of fourteen his schooling came to an end. His father, greatly overworked, desired his assistance in his business, and soon young Oliver was travelling round the Potteries and helping his mother with the office work. For seven years he laboured in these uncongenial tasks as a dutiful son. He might eventually have followed in his father's footsteps,



SIR OLIVER LODGE

but once again his Aunt Anne, who had aroused his interest in astronomy, took a hand in the shaping of his career. In order to get him away from the grind of business for a time she invited him, when he was about sixteen, to spend a winter with her in London. During this brief respite he attended classes on chemistry and geology, and listened to Tyndall lecturing on heat. His interest in physics became absorbing, so much so that in order to take notes of the lectures which he attended he invented a system of shorthand writing of his own.

Returning to his own home, he resumed his duties in his father's business, but his winter in London had determined his career. At Moreton House, Wolstanton, to which the family had now migrated, he snatched time from his business duties to carry out crude electrical experiments in a barn. The Science and Art Department of South Kensington at this time was establishing classes in many towns. To that at the Wedgwood Institute at Burslem young Lodge attached himself, partly as a student and partly as an unpaid assistant. He studied with enthusiasm as many scientific subjects as he could and made up his mind to take the Department's examination in all of them. They totalled eight. He succeeded in getting a First Class in them all, but was too shy to attend the prize giving by the local member of Parliament, at which his ability was highly applauded.

This success led to a second stay in London, this time with the aid of a Government grant of thirty shillings a week, to enable him to attend courses of instruction for teachers at South Kensington. He now studied biology under Huxley and chemistry under Frankland. His thirst for scientific education was not, however, satisfied by the South Kensington courses. He attended evening classes in mathematics, mechanics and physics at King's College. He passed his examinations with high distinction and was offered a post at £200 a year as science master at a school in Jersey. His father, however, disdainful of science as a career and still bent on making his eldest son his partner in his business, bade him return home to resume his former duties.

Still against his father's wishes, he continued his scientific studies. He matriculated at London University, passed, at the second attempt, the first of the two examinations for the B.Sc. degree, tried for a natural science scholarship at Cambridge, was placed *proxime accessit* and was offered a sizarship which he declined. Then Carey Foster appointed him to take exercise classes in physics and to work in his laboratory at University College, London, at a salary of £50 a year. For three years he lived in a single room lodging in Camden Town, studying hard and existing frugally but his feet were now firmly set on the pathway to a scientific career. In due time he passed the second examination for the B.Sc. degree and in June, 1877, he proceeded to the D.Sc. degree examination, which he passed with ease in his selected subject, electricity.

In 1876, while still continuing his work at University College, he was appointed to teach physics at Bedford College for women—an institution which still flourishes, but which has long since shed those Victorian ideas of propriety, which, among other regulations, required that an elderly lady, who usually brought her knitting with her, should sit in the class room during lectures to act as a chaperon. Later, Lodge undertook to teach chemistry as well as physics at the College. It proved a severe addition to the other work which he was carrying on at the same time, and it was a great relief to him when in 1881 he was appointed Professor of Physics and Mathematics at Liverpool University College, an institution then on the point of being formed. In the summer of that year, in preparation for his new appointment, he made a tour of Continental universities and physical laboratories. During this tour he met, among many others, Dr. Heinrich Hertz—a name then still unknown in the annals of science—and with him formed a lifelong friendship. At Liverpool he remained until 1900, when Mr. Joseph Chamberlain offered to appoint him as Principal of Birmingham University, then on the point of being created by Royal Charter from the former Mason College. He declined the offer in the first instance, for he was deeply attached to his work at Liverpool, and the friends whom he had made in that neighbourhood. Ultimately, however, he accepted, and in June, 1900, was formally appointed to the post. He stipulated that he should be provided with a research laboratory, should not be immersed in routine work and that he should not be debarred from continuing his investigations in the field of psychic research. These conditions were accepted. He remained in office at Birmingham until 1919, when he retired to a new-found home in Amesbury, in Wiltshire. There his wife died in 1929, and there he stayed on, as he anticipated, "until the so-called end" came to him also. He was knighted in 1902 on the occasion of the coronation of King Edward VII.

Such was the domestic background of Oliver Lodge's scientific career. It will, we think, always be a little difficult to assign him his true place in the history of science. He excelled as an expositor of scientific theory and discoveries and in the course of his life delivered innumerable lectures of a popular or semi-popular kind, such as the British Association's "lectures to working men." In his capacity for popular exposition we may without serious room for challenge trace the working of his inheritance from his ministerial and schoolmaster forbears. But of his original contributions to scientific discovery it must be recorded that there was an element of what can only be called frustration about nearly all of them. With his immense learning and power of thought there was something within him which prevented him from carrying his investigations to completion and reaping the reward of fame to which they would have entitled him. He fully realised that he possessed this defect. At the close of a Royal Institution lecture on the oscillations of a Leyden jar, and the consequent production of ether waves which he delivered in March, 1889, there came a passage which may here be quoted both as an example of his literary style and as illustrating the state of his own mind. "The present is an epoch of outstanding activity in physical science. Progress is a thing of months and weeks, almost of days. The long line of isolated ripples of past discovery seem blending into a mighty wave, on the crest of which one

begins to discern some oncoming magnificent generalisation. The suspense is becoming feverish, at times almost painful. One feels like a boy who has been long strumming on the silent keyboard of a deserted organ, into the chest of which an unseen power begins to blow a vivifying breath. Astonished, he now finds that the touch of a finger elicits a responsive note, and he hesitates, half delighted, half affrighted, lest he be deafened by the chords which it would seem he can now summon forth almost at will." In these sentences there stands revealed the soul, not only of a scientist, but of a poet and a visionary.

One feels almost certain that had he been less of a poet and visionary, Oliver Lodge would have been a greater scientist, but that he would have been happier that way may be strongly doubted. He has himself left it on record that when he was getting near to any result in physics he became afflicted with a kind of excitement which caused him to pause and not pursue the path to its luminous end. He discovered the method of detecting electric waves by means of the coherer, and when Lord Rayleigh heard of it he told him to go ahead, for therein lay his life's work. He had been interested in Maxwell's "ether waves" ever since he had heard of their prophesied existence in the early 'seventies. But he did not follow Rayleigh's advice. He left the work to others, notably to his friend, Heinrich Hertz, and neglected to play his part in the first steps towards the development of wireless communication. Lodge discovered evidence for the existence of Maxwell's waves while making an investigation on lightning conductors. Having done so, he went off on a tour in the Tyrol. Simultaneously and quite independently, Hertz found similar evidence while investigating the laws of the spreading of electric force in space. He applied himself diligently to the further development of the subject with the result that Hertz's and not Lodge's name will always be associated with it.

Again, early in his career at Liverpool, he became interested in the formation of dust clouds in air and in the manner in which dust-free spaces might be created. His discoveries in this direction eventually led to the development of the Lodge-Cottrell process for the deposition of dust and fumes. It was not he, however, but two of his sons who were responsible for the practical development and application of their father's scientific discovery. So, too, the Lodge ignition plug was developed by another pair of his sons from a discovery of their father's which he called the B-spark.

First and foremost Lodge was an expositor of science, almost, one might say, in some instances at least, a champion of causes deemed lost by the majority of his fellow-scientists. His greatest departure from the accepted opinion of his fellows lay in his unshaken faith in the existence of the luminiferous ether, and in his opposition to the Einsteinian theory of relativity. In the early 'nineties he carried out his "ether experiment" at Liverpool, in which he sought to determine by optical means whether the ether was dragged round between two rapidly rotating steel plates. After much care in eliminating spurious effects he came to the conclusion reached previously by Michelson in his celebrated experiment that if the ether existed it did not adhere to bodies moving through it. In explanation of the null effect of the Michelson experiment he contended strongly in favour of the FitzGerald-Lorentz contraction and to the last refused to accept Einstein's theory as indisputably established.

Strangely, while he supported "reality" against relativity, he was from an early age powerfully attracted towards psychical research and firmly believed, like another great scientist, Sir William Crookes, in the existence of psychic phenomena. It may appear difficult to understand how a man completely master of current physical science, with its insistence on experiment and proof, could at the same time become an ardent believer in the occult. Yet so it was with Lodge. He believed in thought transference and the communication of messages from and to the unseen world, and was a leading supporter from 1884 of the Society for Psychical Research, becoming its President in 1901. His belief in spiritualism is, however, we think, to be taken as a proper corollary to his attitude towards life and science generally. There was much of the seer in his composition, and throughout the whole of his career the imponderabilities of science attracted him much more strongly than any practical applications which might be made of scientific discoveries. From the imponderabilities of science to the impenderabilities of the spiritual world was to him but a step, and he took it with a conviction in its justification for which we can at least admire him.

CHARLES FREWEN JENKIN

Dr. C. F. Jenkin, second son of Fleeming Jenkin—"R.L.S.'s" friend—who died at the age of seventy-five on Friday, August 23rd, will always be remembered as the first Professor of Engineering at Oxford University. In 1908, when the Chair of Engineering Science was established, there was violent opposition to the intrusion of such a utilitarian subject into the sacred precincts of classical learning. The Chair had to fight its way into bare existence, and for years after it was the butt of those—there are many of them still—who held the opinion that there was no call for Oxford to follow in the footprints which Cambridge had already made and that the University should not depart from the subjects with which it was traditionally associated. Be that as it may, Frewen Jenkin was elected the first Professor of Engineering Science—note that the title sought to put engineering on a high plane—and largely by his tact and skill the great difficulties of the first few years were got over and Congregation was persuaded to sanction the erection of the school buildings on University Park—completed in 1914.

Jenkin brought to his task exceptional qualifications for his new post. He was at heart a pure scientist and researcher, but after three years at Cambridge he started as a practical engineer, being apprenticed at Crewe, where he became assistant works manager. He then accepted a post as Mechanical Assistant Superintendent at the R.G.P.F., Waltham Abbey. Later he was resident engineer at Nettlefolds Steel Works, Newport, Mon., and for ten years after that he was with Siemens Brothers, rising in time to be works manager and head of the railway department at Stafford.

Throughout his academic career this earlier contact with commercial engineering coloured the scientific courses of his curriculum and gave those students who desired it a feeling of unity with the utilitarian aspects of the Science of Engineering. During the Great War he was made responsible for aircraft materials of all kinds, and of the work he did, and that was done under his inspiration, a record remains in a "Report on the Materials of Construction used in Aircraft and Aircraft Engines," published by the Stationery Office. One subject impressed him most in the course of these investigations. It was the failure of materials by fatigue, and in 1929 he resigned the Chair in order to pursue with greater liberty researches into vibrational fatigue.

He was a Fellow of the Royal Society, a member of the Institution of Civil Engineers, an LL.D., and in 1919 was made a C.B.E.

Letters to the Editor

(We do not hold ourselves responsible for the opinions of our correspondents)

POST-WAR EMPLOYMENT FOR ACTIVE SERVICE MEN

Sir,—I have read the letter over the signature of "L. Andrews" dealing with the above problem.

While it is true that the job in hand has first call on our efforts, both bodily and mental, the problem referred to needs thought, and it is as well to realise that there will not be work available to utilise the men available.

But must we continue, ostrich like, to bury our heads in the dust of moth-eaten economic beliefs, and present our rumps to the slings and arrows of the tribe known as "economists of repute"?

If, as is certainly the case, the comforts and necessities of life can be produced by utilising a mere fraction of the men available, then it is beyond question that those not needed should benefit.

And what class are more entitled to live for the rest of their lives out of the wages of the machine that frees us from toil than those who will have borne the burden and heat of the day during the long years of war?

One gets a trifle weary of the long list of worthy undertakings that can absorb the returning warriors. Let us have them by all means. We have the facilities needed to bring them into being; but let us have them because they are worth having, and not because they give war-weary men the sole title to existence under the existing financial system—a job.

If the existing financial system is to continue to operate in peacetime, whenever that comes, then the first steps taken by the men who control the system will be something on the lines of the Diabolical Cunliffe Currency Commission, which wrecked our hopes of a better world after the last war. I question whether the people will stand for another.

When one realises that we have not yet paid for Waterloo, the thought of the astronomical burden of debt that will be laid upon us in due course is not encouraging, more especially as we know what that debt consists of.

We have got to dismiss from our minds the whole idea of "the job" as vital to existence, and we have to consider matters from the opposite point of view, viz., the grading of the people into those who have done their work for the rest of their lives, those who have a bit yet to do, and those who have to do the work both for themselves, and for those "excused duty."

Personally, I have no doubt whatever that the millenium is getting nearer, and with the object of accelerating its arrival let us remove our heads from the dust of the said moth-eaten economic beliefs, withdraw certain portions of our anatomy from the slings and arrows of outrageous and doubtless outraged financiers, and plan a world wherein we work when we are young, utilising every advance of science and every bit of the wisdom that is in us in order that when the time comes for our bodily strength to fail we may live for the rest of our lives out of the wages of the machine which has made our efforts unnecessary.

Kyrle W. Willans, M.I. Mech. E.
Ilminster, Somerset, August 20th.

PRIORITY

Sir,—I have read your excellent article on "Priority" with great interest.

My experience in the last war impressed on me the immense importance of this subject in any organised effort to speed up production. The difficulties of creating a thoroughly satisfactory organisation are very real, but it is none the less necessary to face them.

A properly thought out system of priority must start with decisions made by the highest authorities as to which of the three Services should, at any given moment, receive priority in the execution of its demands. These decisions must, of course, be modified from time to time, owing to the changing exigencies of the war situation.

Each of the Services must then decide on the best order of priority in regard to its own requirements in terms of supply, but these more or less general decisions must, before they can be made really effective, be carried further, and clear indications should be given of the particular manufacturing establishments (whether Government or private) which are to receive the necessary preference. It is only by this detailed information that those who are engaged in the supply of materials and equipment and in the distribution of labour can act intelligently. It is not enough to know that a particular branch of supply comes first in urgency for the moment; it is necessary also to know which of the particular enterprises engaged in the production of this essential supply are most in need of assistance at any given time.

There is another point of the greatest importance which must always be borne in mind: if we are to put first things first, it goes without saying that second things must be put second, and there is always a reluctance to accept second place—to say nothing of third and fourth. There is only a limited amount of accommodation in the first row of the stalls, and if the pit and gallery attempt to crowd into this accommodation the legitimate occupants are perforce pushed out.

Alfred Herbert.
Whitchurch, Hants, August 24th.

SKILLED LABOUR

Sir,—In your very helpful Leader on the subject of "Skilled Labour," there is one point you have not dealt with in considering the three-shift question. Any arrangement of the kind would have to be more or less a universal one, and that condition would not be easy to attain. A 30 per cent. reduction of hours means less pay, and workers go where the hours with pay are longest. They would probably endeavour to hold two jobs, and in doing so would defeat the object of the three-shift arrangement.

I know that there is an elaborate organisation to prevent men leaving their employment, but it does not work, and if the inducement to leave were still greater, it would be quite impossible to retain men in a three-shift establishment if two shifts with plenty of overtime were being worked elsewhere in the neighbourhood.

(Dr.) James Weir French,
Chairman, Barr and Stroud, Ltd.
Glasgow, August 20th.

Censorship and the Engineering Press

MANY firms were gravely disturbed when, a few weeks ago, they were instructed in a letter from the Ministry of Supply (Iron and Steel Control) that all matter for the editorial and advertisement pages of trade and technical papers must be submitted to it to be censored. This was a serious matter to manufacturers and the Press and it was at once taken up by the Periodical Proprietors' Association, with the result that the order has now been definitely rescinded. As we feel that the course of events must be of interest to our readers who were upset by the original order, we publish below the relevant letters. It opens with a letter from Mr. Percival Marshall, Executive Chairman of the Association, which introduces the correspondence with the Ministry of Supply.

The Periodical Proprietors' Association,
6, Bouverie Street, E.C.4,
August 26th, 1940.

THE TRADE PRESS AND THE CENSORSHIP

DEAR SIR,—May I ask the hospitality of your columns for the enclosed correspondence relating to a recent Censorship matter which greatly perturbed both the iron and steel industry, and the trade and technical Press ?

Stated very briefly, the facts are these. The Ministry of Supply (Iron and Steel Control) recently issued an instruction to a large number of engineering firms that before any editorial or advertising material was supplied to trade and technical journals it was to be submitted to and approved by the Censorship Division of the Ministry of Information. This completely reversed the normal procedure whereby the responsibility of submitting material to the Censor rests on the editor and not on the manufacturer. The instruction, which caused considerable inconvenience both to the manufacturers and the editors, was issued owing to the Ministry of Supply being wrongfully informed as to the facts of the case. The misunderstanding has now been satisfactorily cleared up as the result of a conference at the Ministry of Information.

The instruction from the Ministry of Supply has been withdrawn, as the enclosed letter shows, and the normal censorship procedure restored. The following correspondence explains what has happened and is, I may add, forwarded for publication with the knowledge and approval of the Ministry of Supply (Iron and Steel Control).—Yours truly,

PERCIVAL MARSHALL,
Executive Chairman.

(*From Ministry of Supply (Iron and Steel Control) to Mr. Percival Marshall.*)

August 23rd, 1940.

DEAR MR. MARSHALL,—I am very glad to think that the meeting held at the Ministry of Information last Friday between representatives of the Technical and Trade Press, the Technical Censorship Division and myself, representing the Ministry of Supply, gave the opportunity for a thorough discussion of the question of security and information appearing in the trade papers, and that the result was so satisfactory an understanding on all points. Since this meeting took place you have ascertained that the technical article, which was the original cause of the Iron and Steel Control being asked to circularise iron and steel manufacturers, was in fact passed for publication by the Censor at the Ministry of Information. It is much regretted that this fact was not brought to light at our meeting with representatives of the Technical Press Division of the Ministry. Clearly the request to send out these letters did not take account of the fact that the journal in question was exempt from blame.

I am now writing to you as Executive Chairman of the Periodical, Trade Press and Weekly Newspaper Proprietors' Association to ask that you be good enough to inform your members that the letters to iron and steel manufacturers which the Control were requested to send out, and which have resulted in a very regrettabl emisunderstanding, were sent after due consultation with the Technical and Trade Press Section of the Ministry of Information. If we had been advised, instead, that the withholding of editorial material and advertising copy would result, with consequent prejudice to the trade papers concerned, then these letters would never, of course, have gone out.

In view of the fact that the Censorship Division at the Ministry of Information is prepared to accept, as a full precaution against the publishing of information which might help the enemy, the method of voluntary submission by editors of any doubtful material, and having regard, too, to the assurances which you and Mr. William Will gave on this point, the Control has sent a further letter to iron and steel manufacturers, a copy of which I enclose.

From my own contacts with the Trade and Technical Press extending over a number of years, I retain full confidence in their readiness to exercise the greatest discretion in the national interest, and you may be assured that for my part I will do everything possible to facilitate the mutually important relationships existing between the iron and steel industry and its representative trade papers.—Yours sincerely,

J. L. HENDERSON,
Public Relations Officer.

Ministry of Supply
(Iron and Steel Control),
Steel House, Tothill Street, S.W.1.

(*Latest Letter from Ministry of Supply (Iron and Steel Control) to Iron and Steel Manufacturers.*)

August 20th, 1940.

To all Iron and Steel Manufacturers.

TECHNICAL PRESS

DEAR SIRS,—We now refer further to our letters of July 25th and 30th, and our interim letter of August 3rd.

It had been brought to the notice of the Control that information of possible value to the enemy concerning certain works and processes had recently appeared in one or two organs of the technical Press. In consequence, the Control was requested to advise manufacturers that no information, advertisements, photographs, &c., should be issued to the technical Press without the sanction of the Technical Press Censorship Department of the Ministry of Information.

Representations were subsequently made by various technical papers to the effect that this proposal would cause difficulty and was unnecessarily strict in its terms in view of the practice which we understand that the Editors concerned are ready to observe of voluntarily submitting any doubtful material to the Censorship.

I am to request on behalf of the Iron and Steel Control that manufacturers, when communicating Technical information or material to the Press, will accompany the communication with the reminder that in so far as the matter is to be actually used for publication it should be submitted, in any case of doubt, by the Editor concerned to the Censorship at the Ministry of Information before publication.—Yours faithfully,

T. H. GIBSON, Secretary,
Ministry of Supply (Iron and Steel Control).

(*Reply to Mr. J. L. Henderson by Mr. Percival Marshall.*)

DEAR MR. HENDERSON,—Thank you for your letter of August 17th. I agree with you it is most unfortunate that we were not informed by the Technical Censorship Division of the Ministry of Information that the technical article to which objection had been raised was in fact passed for publication by them in the first instance.

I am very glad that our meeting at the Ministry of Information has now resulted in a satisfactory adjustment of the misunderstanding caused by the various letters recently issued to iron and steel manufacturers by the Ministry of Supply. There is no doubt that this correspondence aroused considerable misapprehension in the minds of the manufacturers concerned, and that it seriously interrupted the normal flow of both editorial and advertising material to the trade and technical Press. This has been the more regrettable in view of the importance of giving the fullest possible publicity to British products at the present time, both at home and overseas, for the vital cultivation of export trade.

Trade press editors are fully alive to the requirements of national security in the matter they publish, and since September last they have worked in close co-operation with the Censorship authorities. They willingly accept the responsibility of submission to censorship of all material which may contain any information of possible value to the enemy, and I have on more than one occasion been assured by the Chief Censor that his relations with the trade and technical Press have been mutually happy and effective. I am glad, therefore, that the Ministry of Supply has, as the result of our conference, been able to withdraw the restriction previously imposed on the iron and steel manufacturers, and I hope that the freedom of communication between that industry and the trade and technical Press will be speedily restored. I will take an early opportunity of explaining the position to the members of my Association, and of reminding them of their responsibilities in this matter.

May I, in conclusion, thank you for the helpful spirit in which you contributed to our discussion of this difficulty, and for your evident desire to remove the misunderstanding at the earliest possible moment.—Yours sincerely,

PERCIVAL MARSHALL, Executive Chairman,
Periodical, Trade Press, and Weekly
Newspaper Proprietors' Association.
6, Bouverie Street, E.C.4.

American Engineering News

Continuous Casting Process

The Williams casting process, which has been developed in the United States, provides for the continuous casting of ferrous and non-ferrous metals into ingots of indefinite length and of extremely high quality. There are claimed to be no surface defects on the ingots and there is no cropping or discard. The ingot is cut into desired lengths by saw or torch, as it comes from the mould. Its length is limited only by the amount of molten metal available, and it is planned to install the plant at steel works where a continuous supply of molten metal will be available. Heat is removed from the metal as it is received in the mould, so that the metal in contact with the wall of the mould is cooled very rapidly, forming a thin skin or shell. The mould has a thin lining of copper, brass, or other metal of high thermal conductivity. As the molten metal is poured its heat passes rapidly through this lining and is "washed" away by a sheet of water flowing rapidly along the outside. The speed and quantity of water depends upon the character of the metal being poured. With this rapid cooling there is a shrinkage of the skin of metal on the ingot, so that there results very little wear on the wall of the mould. Further cooling is effected by water sprays playing on the exposed ingot as it emerges, the rate of cooling being controlled by the amount of water spray. Rolls just below the mould work the ingot and reduce it to size, while its centre is still plastic. Molten metal is poured into a box or hopper from which it flows in a continuous stream through a nozzle and into the mould, and the solidified ingot is withdrawn steadily by live rolls. The metal is poured at 150 deg. to 200 deg. above its melting point, and an ingot 4in. square is produced at a rate of 5ft. to 7ft. per minute. Sheets and light structural shapes can be produced, thus eliminating rough forming and rolling operations. Advantages claimed are the high quality of the metal, the elimination of imperfections on the ingots, and the utilisation of practically 100 per cent. of the metal poured.

Sinking Steel Submarine Tunnels

Building steel tubes and floating and sinking them in place to form submarine tunnels is a method used in several cases and applied recently on two projects in the United States. At Chicago a "tube" 40ft. by 23ft. and 200ft. long has been sunk in the Chicago River for the double-track State Street line of the new underground railway, now under construction. When floated into position two powerful floating cranes took hold of it and controlled its sinking as it was loaded with pre-cast concrete blocks. The ends were enclosed within cofferdams, so that the bulkheads closing the tube could be removed. A tube tunnel 2000ft. long has been sunk at Mobile to carry a main highway under the Mobile River. This was done in seven sections, 255ft. and 300ft. long. Each section was built up of steel plates with welded joints. After a section was completed the temporary end bulkheads were fitted, all joints washed with soapy water, and 5 lb. air pressure applied to locate any leaks by bubbling. Very few leaks developed. Concrete was filled in at the bottom and sides and the tube was then towed to the site, where a floating plant pumped in concrete between the two shells of plating at the roof. Electric ducts were placed and additional concrete pumped in to complete the lining, the whole being then grouted to fill any voids. For control of the sinking two gallows frames were erected over the ends of the tube and equipped with four 15-ton chain blocks. Pins in the end of one tube fit into holes in brackets on the other tube, and the ends are drawn up tight by ratchet jacks operated by divers. Also the end of one tube enters an annular socket on the end of the next tube, in which is a rubber and hemp gasket. The inside shells are then united by welding a plate over the joint. When the tube is within 4in. of the bottom of the dredged trench, sand filling is pumped in to fill the bottom and sides.

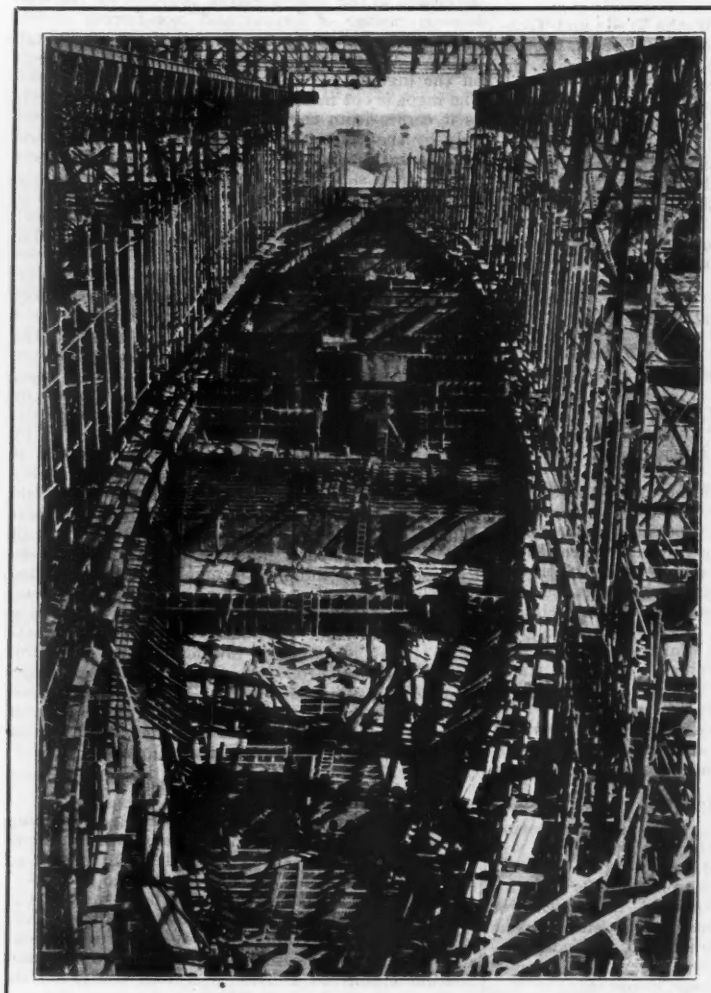
INDIAN RAILWAY EARNINGS.—It is stated that during May, the second month of the new financial year, the earnings of Indian State Railways continued to increase. For the first ten days of that month the earnings amounted to Rs. 4315 lakhs, or Rs. 340 lakhs in excess of the approximate gross earnings during the corresponding period last year.

NEW RAILWAY IN SOVIET FAR NORTH.—The building is in progress in the Soviet Republic of Komi of a new railway—the Ukhta-Pechora Railway—to connect the basins of the Pechora and Vychegda rivers with the existing railway system of the U.S.S.R. The new line, which starts beyond the Arctic Circle, will be 808 miles long. It runs through regions rich in coal (the Vorkuta basin), oil (the Ukhta fields) and other mineral resources, as well as through forest lands and fishing centres. Starting beyond the Arctic Circle, the new line will run south-west through Vorkuta, Chibyu, Knyashpogost and Kotlas. At Konosha it will join the Northern Railway. More than 186 miles of the new line have already been put into operation, and it is expected that railway services will be established from Kotlas to Chibyu in the Ukhta oilfields, a distance of 320 miles, before the end of the year.

BUILDING AND LAUNCH OF THE LINER "AMERICA"

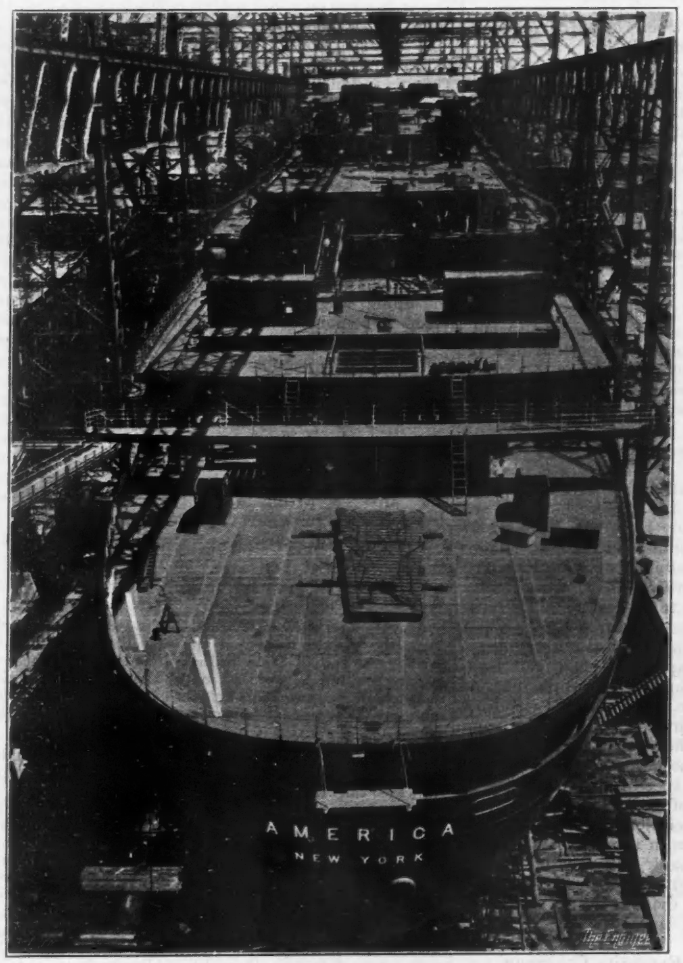
NEWPORT NEWS SHIPBUILDING AND DRY DOCK COMPANY, NEWPORT NEWS, VA., BUILDERS

(*For description see opposite page*)

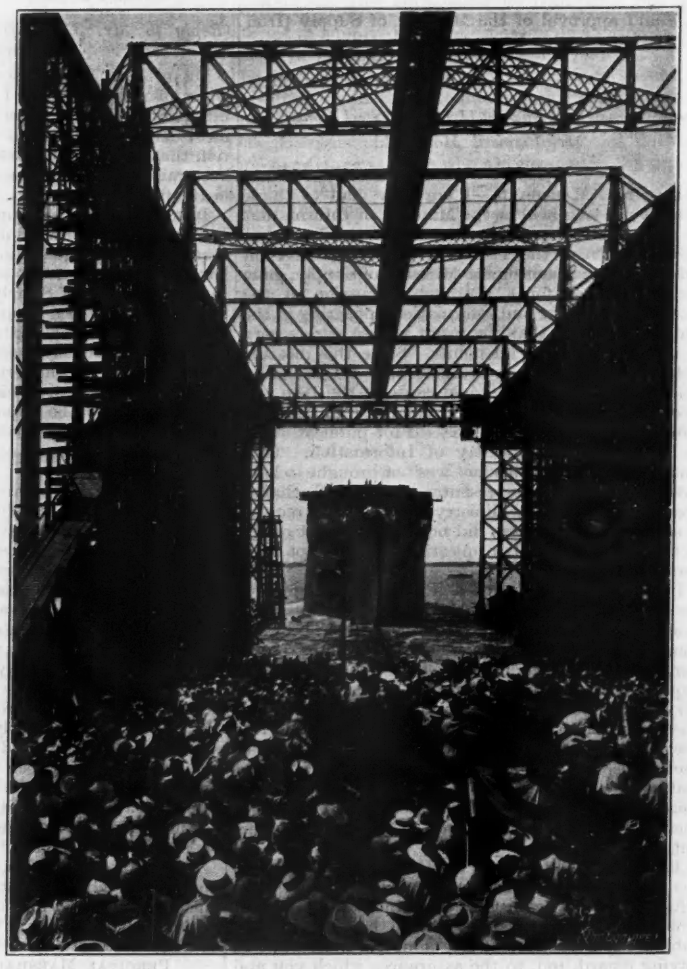


HULL COMPLETED TO "C" DECK

BOW VIEW

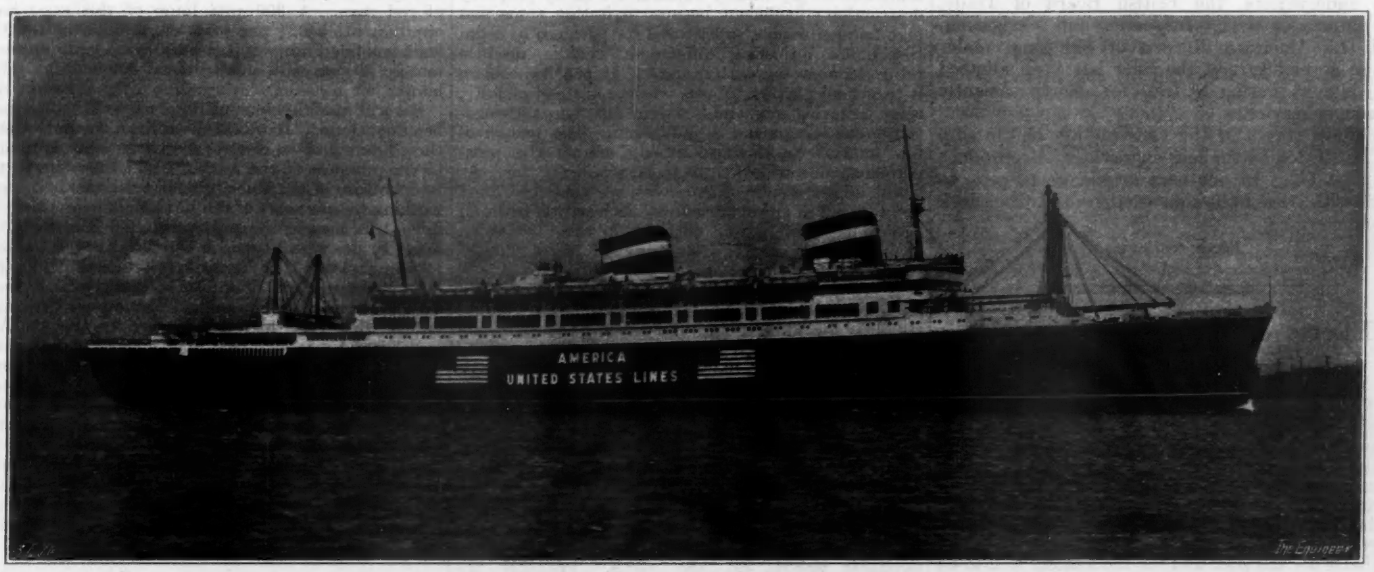


STERN VIEW



LAUNCH

UNITED STATES 27,000-TON LINER "AMERICA"



The United States Liner "America"

No. I

ON Wednesday, July 29th, the flagship of the United States Lines Company, which, after undergoing successful trials, was delivered by the Newport News Shipbuilding and Dry Dock Company, of Newport News, Va., to her owners on July 2nd, arrived in New York to take on passengers and proceed on her maiden voyage to the West Indies. This large liner, which is one of the finest ever built in an American shipyard, was greeted by thousands of spectators. Some account of her design and construction will be given in this and succeeding articles.

We are indebted for the information given herewith to a paper which was presented to the American Society of Naval Architects and Marine Engineers at the spring meeting, which took place at Newport News on May 17th, by Mr. Harold F. Norton, the naval architect, and Mr. John F. Nichols, the chief engineer of the Newport News Shipbuilding and Dry Dock Company. We have also to thank the London office of the United States Lines, which has placed at our disposal photographs which were not included in the paper. Four of these are reproduced opposite. The above engraving shows clearly the distinctive appearance of the liner, which is marked by the slightly curved raking stem, the high freeboard forward and the streamlining of the bridge and superstructure. The two funnels, which are widely spaced, are pear-shaped in section, and have an unusual Sampan top, the purpose of which is to deflect the smoke from the sports deck. These are some of the main features of an outstanding liner.

The "America" was designed as a flagship of the United States Lines fleet for a fast and efficient passenger and cargo service with the "Washington" and the "Manhattan" between New York and Hamburg, calling at Cobh, Plymouth, Southampton and Le Havre. Unfortunately, the war has interfered with the original service of the ship and after being laid up for some weeks she has taken up cruising work from New York.

The design, which was finally selected by the owners and approved by the United States Maritime Commission and the United States Navy, was developed by Messrs. Gibbs and Cox, Inc., the New York naval architects and the owners' representatives. It was the culmination of a long series of designs developed by Messrs. Gibbs and Cox and also, at the owners' request, by the Newport News Company. At the various stages of development the owners had pointed out the features they considered undesirable and selected those they regarded as desirable in each design. They had also consulted the Maritime Commission and the Navy. The result is an arrangement which represents what seems to be the best composite of the ideas of all, even though it may not completely meet the ideals of each. The consultants and builders collaborated in checking the hull and engineering design characteristics and also the weights, moments, stresses, power, speed, economy, stability, and floodability and stability in damaged condition.

The work was well begun before 1935 and was not finally completed until several months after the signing of the contract on October 21st, 1937. During that time eight tentative and different designs had been produced by the Newport News Company, and at least an equal number by Messrs. Gibbs and Cox. The designing started with somewhat vague ideas of duplicating the previous ships, the "Washington" and the "Manhattan," while incorporating new ideas, but it ended with a ship distinctly different in its arrangement and slightly larger in all the principal dimensions. The principal dimensions and particulars of the design adopted are given in the accompanying table.

Principal Dimensions and Data

Length overall	723ft.
Length on 32ft. 6in. water line	690ft. 3in.
Length between perpendiculars	660ft. 6¾in.
Beam moulded, maximum	93ft. 3in.
Beam moulded at 32ft. 6in. water line	91ft. 11½in.
*Depth moulded to sports deck at side amidships	92ft. 4¾in.
*Depth moulded to sun deck at side amidships	82ft. 4¾in.
*Depth moulded to promenade deck at side amidships	73ft. 4¾in.
*Depth moulded to upper deck at side amidships	64ft. 5¼in.
*Depth moulded to main deck at side amidships	55ft. 5¼in.
*Depth moulded to main deck at lowest point of sheer	55ft.
Height between main and "A" decks, frame 162	10ft.
Height between "A" and "B" decks, frame 162	9ft.
Height between "B" and "C" decks, frame 162	8ft. 6in.
Height between "C" and "D" decks, frame 162	9ft. 6in.
Load draught, moulded	32ft. 6in.
Load draught to bottom of keel	32ft. 8¾in.
Sheer forward at forward perpendicular	11ft.
Sheer aft at after perpendicular	2ft. 10in.
Camber, upper deck and above, in 86ft.	3in.
Camber on main deck and below	None
Displacement, full load, tons	35,440
Tons per inch immersion at 32ft. 6in. moulded draught	110
Deadweight, full load, tons, approximate	13,061
Gross tonnage, approximate	27,000
Net tonnage, approximate	15,000
Block coefficient at full load draught	0·5859
Maximum section coefficient at full load draught	0·9772
Prismatic coefficient at full load draught	0·5996
Water plane coefficient	0·7147
Cargo, general, cubic feet, bale	About 265,000
Cargo, refrigerated, cubic feet, net	About 33,500
Ship's cold storage, cubic feet, net	About 34,350
Baggage space, cubic feet, net	About 19,650
Mail space, cubic feet, net	About 30,000
Shaft horsepower, normal	34,000
Shaft horsepower, maximum	37,400
Designed speed, in excess of	22 knots
Cruising radius, miles, at 22 knots at load draught	About 11,000
Cruising radius as above at 15 knots	18,000
Fuel capacity, 97 per cent. full, tons, at 37·1 cubic feet	4938
Tanks available for water ballast, tons	2238
Fresh water, tons, 100 per cent. full	4733
Compartmentation, flooding and stability flooded	3 compartment
Metacentric height estimated to be necessary for 3-compartment flooding (without margin)	About 4ft.†
Cabin passengers	543
Tourist passengers	418
Third-class passengers	241
Total passengers	1202
Crew	643

* NOTE.—Lowest point of sheer is aft of amidships, frame 162.

† The inclining experiment had not been performed at the date of writing. This GM plus a margin is anticipated. The estimated necessary GM varies between about 3·90ft. and 4·2ft., depending upon the operating condition.

Perhaps the most unusual feature of the Gibbs and Cox arrangement which was finally adopted by the owners is the separated boiler-rooms with the engine-room in between, the uptakes being carried through the machinery hatch. All the three main machinery spaces are protected from collision damage by deep fuel oil tanks arranged on each side. It is understood that this arrangement for the machinery was favoured by the Navy, as desirable in case of use as a naval auxiliary vessel, and by the owners as interfering least with the arrangement of the public rooms. It also permitted an unusual disposition of the ship's stores which was favoured by the owners. It has the disadvantage of dependence in the machinery spaces upon forced ventilation and less ready accessibility for making repairs to the machinery. Compared with the previous ships, the arrangement adopted is new, in that the tourist accommodation is placed aft and the third class forward, with interchangeable rooms on the B deck, while all the public rooms are larger and differently arranged. The cabin-class promenade deck is also more extensive and the sports deck larger than in the "Washington" and the "Manhattan," and more elaborately fitted.

The final lines of the "America," which were selected by Messrs. Gibbs and Cox, and approved by the Maritime Commission, from consideration of the results of tests made in the United States Experimental Model Basin of several models independently produced, were those developed by the hull technical department of the builders after testing some fifty different models in their small model tank at Newport News. The contract allowed four months for collaborative work on the final design characteristics and dimensions. The beam of the ship and its lines were approved by Messrs. Gibbs and Cox, thus finally releasing the final design for actual construction on February 8th, 1938, about two weeks less than the time allowed for in the contract.

The first rivet was driven and the keel laid by Admiral Land, the Chairman of the Maritime Commission, on August 22nd, 1938, and the ship was christened and launched by Mrs. Franklin D. Roosevelt, the wife of the President, on August 31st a year later. At the launching the weight of the ship was 16,870 tons, and the pressure on the grease about 1·94 tons per square foot. The inclination of the ground ways was $\frac{9}{16}$in. per foot, and when the triggers were released the ship started promptly from the ways. The maximum sliding speed recorded was 18·4ft. per second. The technical features of the launching were given in an article which was contributed to the *Marine Engineering and Shipping Revue* of October, 1939, by Mr. Vincent.

The "America" was completed and was ready for trials in the early part of June, 1940, and

she was delivered to her owners on July 2nd. She was built and equipped according to the regulations of the Public Health Service, the fire underwriters, the British Board of Trade, the Bureau of Marine Inspection and Navigation, and the American Bureau of Shipping, under whose special survey the liner has been allotted the highest rating A.I.E. for North Atlantic passenger service.

Various stages in the construction of the ship are illustrated by the four engravings we reproduce on page 142. In our next article we propose to deal with the hull construction and the deck machinery.

(To be continued)

Effects of Engineering in the Present Age*

In our present state in the western world we have reached an age when the effects of engineering run through all conditions of living. We of the western world have so profited by active prosecution of scientific discovery, invention, and refinement of engineering processes that our conditions of life for all but the most wealthy are in strong (indeed startling) contrast with the woeful conditions of living available for the poor and the moderately well-to-do in those eastern countries which have failed to participate in such developments. We have further improvements to make. For illustration, it is a fact that we have not yet developed the human contacts, in those of our industrial organisations in which production by machines is prominent, so as to reproduce the friendly responses that are possible among industrial groups, and which were observable in the best of old-time hand-work conditions. Such defects, however, gradually become rectified as the modified social relations gain recognition.

With us, all engineering works—good structures for shelter, hard-surfaced roads, bridges, railways, ships, water control, regulation of rivers, improvement of harbours, construction of lighthouses to safeguard navigation, telegraphs, telephones, radio, metallurgical processes, steam power, machinery, automobiles, good artificial illumination, erection of great structures, manufacturing processes, and the like—play an important part in bringing people into more intimate personal contact by increasing community life or by enabling it to subsist, and by associating rural populations and community populations with each other. Machines provide the capstone in this development.

These engineering influences conjointly lifted the peasant populations of Europe from serfdom to reasonable security and freedom—from sordid poverty and marginal living to conditions of relative security of livelihood and happiness—by making mutual contacts easy for the people, increasing mutually sympathetic relations, and assuring prompt transportation of goods when and where needed or desired. The added effects of great activity in scientific discovery and invention have brought for every group of our American people (except those in the richest groups) a higher level of living than has ever been attained in corresponding groups elsewhere. While we now enjoy these advantages compared with earlier centuries, the common people of nations which have failed to cultivate the opportunities of science and engineering still live a marginal life, suffering from the elements and from near-starvation. What is true in these contrasts between nations is also true in contrasts between industries in each nation.

Can we afford to slacken our efforts at the scientific discovery and invention which have produced so much for us and give promise of continued contributions of service? We want still better conditions for every one of us, and, particularly, betterment of the conditions of citizens who are in the groups of lowest welfare is wanted for them and by them. Hope for such results lies in improving the conditions of economical and plentiful production, and the historic precedents show that for such results scientific discovery and engineering invention are our reliance. It is right and natural for each individual to wish for better conditions and to the extent of his ability seek means for securing the fulfilment of the wish. The only useless human beings are those few who are on the bottom level of living conditions and have no wish to help themselves to go higher. They must be helped in some way; but how? That is a difficult problem to solve. Purely sentimental processes will not produce desirable results.

Engineering processes and engineering devices have been (and are being) abused by use in warfare, and much of the poverty now found in various nations is an aftermath of costly wars which sacrificed productive men and valuable property. This is not by choice of the leading minds of the engineering profession. The profession with few exceptions stands on the conviction that, besides being inhuman, war is tragic, expensive, inefficient, and unnecessary—tragic because of its track of human wastage, hardships, and sorrows; expensive because of its wanton destruction of desirable wealth, which may be represented either by money expenditure or by property destruction; inefficient because irritating steps and high-handed action, substituted for patience in negotiation for adjusting differences, seldom produce returns comparable with the costs. Hence the problem is to get all parties to use wisdom instead of folly, cease irritating acts, and put their differences to negotiation and impartial adjudication. The people of few nations (and those mostly among the prosperous small nations) seem to be ready for this. As world affairs display themselves, we therefore must be prepared in an organised way as a nation to stand against aggression from without, in case aggression should arise in spite of friendly negotiations planned to prevent forcible action.

If every man can ever be convinced that war will not ultimately result in greater wealth, security, and stability for himself and his nation, the tendency toward organised war will be weakened. Especially will this be achieved if other sufficient routes are kept open on which men's love of risk and adventure can be fully expended, and the paths of selfish profit during war are closed. Individual quarrelling or collective war have always existed in the world of man; and they continue jointly with us to-day, as we know to our frequent regret. The results of scientific discovery and invention have given war a more comprehensive and frightful aspect, but they also have given greatly increased populations and largely magnified available wealth on the earth. Probably the proportional destructiveness of war is no greater to-day than it was millennia ago, when entire populations were destroyed or converted into slavery as the consequence of wars.

It is not science or engineering which is at fault. The defects in human relations which arise in our day in local, national, and international affairs are not due to faults in the fundamental ideal of a complete civilisation, nor to a scientific engineering which has set up and continues to maintain the stage for a possible realisation of that ideal. The fault lies in the lag of human intelligence with respect to its opportunities for bettering human conditions. Deficient business morals and spread of crime in a country like ours, and the insistence of sovereign governments of a right to do as they please without regard to generally accepted ethics or to solemnly made agreements, indicate a lack of confirmed principles of ethics held by the people and by government leaders. The human mind, in mass, is very slow to change in character; and stable improvements of mutual relations cannot be rushed to success by the vaguely applied efforts of professional reformers or dilettantes in social affairs. Such improvements may only be successfully produced slowly in association with sounder-growing mass thought regarding living affairs in both material and ethical relationships.

* From a paper by Dugald C. Jackson, D.Eng., Past-President, American Institute of Consulting Engineers and American Institute of Electrical Engineering—*Journal* of the Franklin Institute, July, 1940.

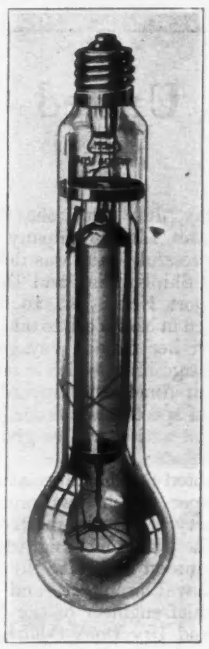
Sieray Electric Lamps

Since the Sieray electric lamps were first introduced by Siemens Electric Supplies, Ltd., some notable factory and other lighting installations involving their use have been put into service. The Sieray dual lamp differs from other types of electric discharge lamps in two respects, namely, it does not require a choke or condenser and the light emitted is of a more pleasing colour. With the elimination of the choke and condenser no alteration to the existing wiring need be made and the lamp can be screwed into an ordinary Goliath holder to operate directly off the mains supply. Essentially the lamp consists of a mercury discharge portion connected in series with a tungsten filament, the outer bulb of the discharge part being expanded, as shown in the accompanying illustration, at the lower end to accommodate the filament, which serves not only to stabilise the arc of the discharge, but operating at its normal efficiency acts as a supplementary light source, emitting light in which a considerable proportion of red rays is present. Since the deficiency in red rays from the discharge tube is rectified, the resultant light is of a pleasing colour.

Undue overloading of the tungsten filament, when switching on is obviated by the provision of an auxiliary filament, which is automatically switched out of circuit by a thermal cut-out at a predetermined time in the run-up characteristic of the discharge tube. As the arc discharge is stabilised by the resistance of the tungsten filament, the power factor of the circuit is not lowered as with choke control, and consequently a condenser in the circuit is not required. The power factor of the Sieray-dual lamp is approximately 0·95.

Immediately the lamp is switched on a considerable amount of illumination is obtained and after about ten minutes the lamp reaches its full luminous output with the filament and discharge operating at their correct efficiencies. Marketed in sizes with total rated consumptions of 300 and 500 watts in the case of A.C. and 500 watts for D.C., all these lamps must be installed with the cap up in the vertical position. The bulk of the light is emitted by the discharge tube, whilst the light from the tungsten filament is employed to build up the total lumens output and also to rectify the shortage of red rays in the light emitted by the discharge tube. The resultant light from Sieray-dual lamps contains approximately 8 per cent. of red rays. A 300-watt lamp of this type gives approximately 33⅓ per cent. more light than a 300-watt gas-filled lamp and the 500-watt lamp approximately 50 per cent. more than a 500-watt gas-filled lamp.

Several modifications of the design described have been developed. It was realised from the outset that the efficiency of an electric discharge lamp is related to the pressure of the mercury and therefore to the temperature of the inner tube, but the maximum safe working temperature of the hard glass composing the inner tube has in the past precluded increasing the mercury pressure beyond a comparatively low limit. But in the "Q H" Sieray lamps this difficulty has been overcome by the use of a special grade of quartz which has made possible the introduction of low watt lamps with very high efficiencies for use on A.C. supplies. A quartz inner tube is enclosed in a pearl-finished outer bulb, similar to that used for tungsten lamps, the arc source being short and very concentrated as compared with the arc in other Sieray lamps. This concentration of the light source introduces various advantages. The time taken by the lamp to reach full luminous output is considerably shortened, the cooling time after switching off, and consequently the lapse of time before re-striking can take place are considerably reduced, and the lamps



Sieray Electric Lamp

can be used effectively in standard types of fittings designed for gas-filled lamps. Moreover, these "Q H" lamps can burn in any position.

But as these lamps require a choke in circuit they are fitted with a special three-pin bayonet cap to preclude insertion into a holder wired for tungsten filament lamps. The higher working pressure of the "Q H" type results in the emission of light with a spectrum of a more continuous nature than that of a standard type of medium-pressure mercury lamp. As a small proportion of red rays is present the colour definition is slightly improved, but in the main the light quality is that of standard medium-pressure mercury discharge lamps. This type of lamp is available in two sizes with consumptions of 80 and 125 watts respectively for use on A.C. mains working at 200–260 volts. The luminous outputs for the 80 and 125-watt sizes compare favourably with those of 200-watt and 300-watt tungsten filament gas-filled lamps respectively.

The standard form of Sieray lamp is manufactured in two types—the Sieray "H" and "W" types, designed to operate on A.C. mains at 200–260 volts. The "H" type can be supplied in 250 and 400-watt sizes with initial lumens outputs of 9000 and 18,000 respectively. Quality of light which shows a marked improvement over that of the ordinary medium-pressure discharge lamp is the principal feature of the "W" type lamp, this improvement in colour being obtained by the addition of certain metals to the mercury contained in the tube. The proportions and vapour pressures of these metals are so arranged as to make their colours complementary to those emitted by mercury vapour and the resultant quality of the light is greatly improved. The "W" type lamp is only supplied in the 400-watt size.

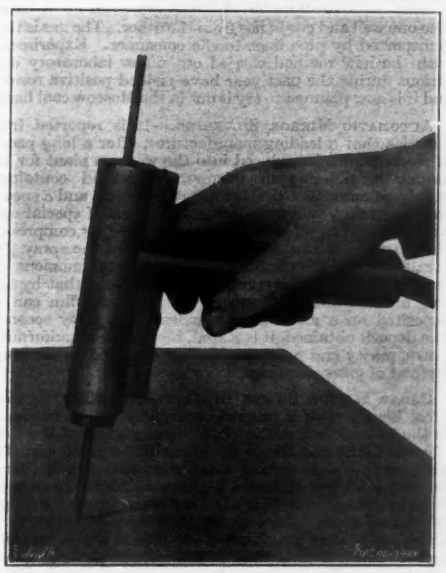
Standard types of Sieray lamps are alike in general construction. To ensure good ionisation when the lamp is first switched into circuit the method employed is the same in all types and consists of the use of auxiliary electrodes in close proximity to the main electrodes. These auxiliary

electrodes set up a preliminary discharge, which induces the main discharge to start between the two principal electrodes, and when the main discharge is in operation its lower resistance automatically cuts out the auxiliary electrodes.

If standard Sieray "H" and "W" lamps are operated in the horizontal position, convection currents inside the inner tube will cause the arc to blow upwards with destructive effects to the tube. But since the arc is metallic, the effect of these convection currents can be neutralised by means of an electro-magnetic device incorporated in the lanterns. Specially designed "H" type lamps can, however, be supplied to operate in any mounting position from the vertical to horizontal without employing a magnetic deflector. In appearance and general design these lamps are similar to the standard type, but are etched for identification purposes with the words "for horizontal burning." Sieray ultra-violet lamps, fluorescent and sodium lamps are also made.

Hand Carbon Arc Welding

Automatic carbon arc welding is now generally accepted in a number of industries as the most suitable welding process for dealing with repetition work involving a succession of long runs. The carbon arc is essentially a fusion welding process, primarily suitable for edge and corner joints in mild steel. High welding speeds are obtained, and in light sheet metal work no filler wire is necessary; in addition, the carbon consumption is very low, resulting in a most economical and simple method of fusion welding. There are, however, a large number of applications suitable for carbon arc welding, in which, owing to



Carbon Arc Torch

high initial cost or for other reasons, the automatic or semi-automatic method cannot be employed. This remark applies particularly to light sheet metal work involving short or irregular runs in medium quantities.

To meet the requirements of this type of work Siemens-Schuckert (Great Britain), Ltd., has developed a new carbon arc torch for hand welding. Two sizes are available, for currents up to 80 amperes and 160 amperes, and suitable for welding material from 20 S.W.G. to $\frac{1}{16}$in. Any size of carbon up to $\frac{1}{4}$in. diameter can be used as required without making any adjustment to the torch. A powerful blow coil incorporated in the carbon holder ensures the steady arc, which is necessary in order to obtain good consistent results. Special attention has been paid to the question of fatigue, and in addition to reducing the weight as far as possible, the balance has been carefully adjusted to reduce strain on the operator.

Small Tools Distribution.—It has been realised for some considerable time that whilst the supply of new small tools, such as milling cutters, reamers, taps, &c., has, to say the least, been very difficult, there must be thousands of such tools in perfectly good condition lying idle and almost forgotten in the tool stores of engineering firms—great and small—throughout the country. The question has been discussed by some of our engineering institutions and associations, but it has no doubt been realised that any attempt to formulate a scheme for the pooling of tools on a voluntary basis can hardly be successfully accomplished. A company—Tool Distributors, Ltd., 17, Redcliffe Street, Bristol—has therefore been formed, with the approval of the Ministry of Supply, in an endeavour to put into operation such a scheme on a commercial basis. It is the intention of the new company to acquire by purchase or any other means at its disposal new and second-hand small tools of every description, and these tools will then be available on hire for periods of one week and upwards at a weekly rental basis.

Markets, Notes and News

The prices quoted herein relate to bulk quantities. Unless otherwise specified home trade quotations are delivered f.o.t. Export quantities are f.o.b. steamer

Our July Exports

The collapse of the French resistance and the entry of Italy into the war are two of the main factors which account for a sharp decline in our export trade in July. According to the Board of Trade, which since the war has published only abbreviated returns, the total value of goods of United Kingdom manufacture exported in July was £31,189,244, a decrease of £5,022,214 compared with June. Compared with July, 1939, the decrease was £9,165,781, which is wholly attributable to the cessation of trade with the enemy and with enemy-occupied countries in Europe and to the inaccessibility of the Baltic and Balkan states and Switzerland. Coal shipments in July were £1,753,292, a decrease of £1,998,574 compared with July last year. Exports of coke and manufactured fuel at £85,515 were £241,954 less, while those of iron ore and scrap receded by £19,681 to £1799. Exports of non-metalliferous ores and scrap were also heavily down by £173,981 at £3989. Exports of iron and steel and manufactures dropped about one-third, the figures for July this year being £2,291,734, compared with £3,490,438 in July, 1939. Shipments of non-ferrous metals and manufactures thereof recorded a drop of £497,226, the total value being £778,261. The shipments of cutlery, hardware and implements and instruments amounted in value to £805,983, a decrease of only £46,283 compared with July, 1939, while those of machinery were £1,937,826 lower at £2,496,590. Exports of electrical goods and apparatus, however, at £1,083,296 marked an increase of £47,912. The value of exports of vehicles, including locomotives, ships and aircraft totalled £1,869,511, a decrease of £1,553,361.

Imports in July

There was again a decrease in our total imports in July compared with June, the figures being £87,007,530, against £90,779,141, but they amounted in value to some £10,000,000 more than in July, 1939, when the figure was £78,251,309. Compared with July last year, the arrivals of iron ore and scrap at £1,651,440 were £424,569 higher. This was also the case in non-metalliferous ores and scrap, which totalled £1,768,704, an increase of £485,266. The value of the imports of iron and steel and manufactures thereof in July totalled £3,173,685, showing an increase on July last year of £1,263,002. Imports of non-ferrous metals and manufactures were nearly double those of July, 1939, recording actually a rise of £3,765,518 and amounting to a total value of £7,790,464. Imports of cutlery, hardware, implements and instruments, on the other hand, were heavily down, totalling £170,420, against £567,048, while electrical goods and apparatus also marked a decrease, but to a lesser extent, at £173,301, against £245,133 in the same period of last year. Machinery imports in July were a little higher, the total being £2,297,459, compared with £2,289,597 in July, 1939. The value of the imports of vehicles, including locomotives, ships and aircraft, totalled £3,229,988, a heavy increase when compared with £312,487 in July last year.

The Pig Iron Market

There has been no change in the general pig iron situation in this country during the past week. The demand is intense for nearly all grades, and the position is most satisfactory, from the consumers' point of view, in the case of foundry grades. The reason for this, of course, is that this material is largely used by works making castings for the building trade and the onset of the war, which has resulted in a sharp setback in the latter industry, has greatly diminished the demand for foundry pig iron. Even here, however, there are signs of a gradual expansion in the demand, as more and more of the light castings plants are being turned on to new work connected directly or indirectly with the war effort. The production of foundry pig iron is not excessive, and on the North-East Coast, for example, the local consumers find themselves mainly dependent on day-to-day deliveries from the Midlands. The Cleveland blast-furnaces are concentrating their attention on the manufacture of more important descriptions of pig iron for steel making purposes. The demand for hematite appears to be in excess of the supply; makers' stocks are practically exhausted and they are only prepared to supply priority users in possession of official licences. At one time recently there seemed a possibility that the hematite furnaces might not receive adequate supplies of ore; but this position has now been fully remedied. Apart from the fact that new sources of supply have been brought into play, iron ore is still coming into this country from the Mediterranean, despite all Italian and German efforts. In the Midlands the current production of pig iron is being absorbed under existing contracts and consumers do not find it possible to carry more than small stocks at their works. Conditions in Scotland are in line with those ruling at the other important pig iron producing centres in Great Britain, and there is a good demand for steel-making iron. The situation is easier here in the case of foundry iron owing to the partial slackness in the Scottish light castings industry. Supplies of foundry iron continue to be imported from the Midlands. As regards Lancashire, substantial supplies of Midland foundry pig iron are coming forward, though in somewhat smaller tonnages than could be easily absorbed.

The North-East Coast and Yorkshire

The slogan at all the works on the North-East Coast remains "full speed" ahead, and holidays are being ignored. Outputs are at record levels. The raw material position seems to be more satisfactory than it was, and the total output of iron and steel is sufficient to meet the intense demand for defence purposes, thanks to the supervision exercised over the allocations by the Iron and Steel Control. Some anxiety is expressed both in producing and consuming quarters regarding the railways' latest application for higher charges, and it is feared that if this permission is granted it will inevitably mean a further advance in home steel prices. So far there is not much evidence that the Government is allocating export permits for steel with any marked degree of freedom, in view of the declared British official policy; but this movement must, of necessity, be a slow development. The industry is no longer perturbed over the cessation of supplies of Continental semis, as satisfactory deliveries are now coming forward from America. Production at the re-rolling works is extremely active. In the heavy steel trade there is an intense demand and high outputs are the rule. The shipbuilding and engineering industries are in need of huge tonnages of steel, and the sheet mills also are booked up a long way ahead. Active conditions prevail in the Sheffield region, with a widespread demand for all grades of steel, particularly special steel.

The Midlands and South Wales

Every branch of the iron and steel industry in the Midlands reports an increasing demand for materials in connection with the war effort. Constructional engineers are heavily engaged on urgent contracts involving the consumption of very large tonnages of joists, sections and other heavy steel descriptions, and special steels for armaments of all kinds are in keen request. The re-rollers' anxieties regarding supplies of semis seem on the way to being dissipated by the prompt measures of the Control to obtain huge monthly tonnages of American steel as soon as Continental supplies were cut off, and they are actively employed on the manufacture of small bars, sections and strip. The Midlands output of pig iron is being promptly absorbed locally and by consumers in other parts of the country. Naturally, steel makers in this district do not look with much favour on the railways' latest move to enforce still higher charges. The South Wales steel industry also continues extremely active, despite recent enemy air activity over the country. There is an enormous demand for iron and steel for war needs, and the works are operating at top pressure. It would be difficult to cope with the situation but for the official rationing scheme, which ensures that priority demands have first call on the output, and this leaves little for ordinary trade buyers at the moment. The position as regards semi-finished steel is being considerably assisted by the importation of material from the United States. The tin-plate trade, however, is not so busy as it was, and will presumably need less sheet bars in the immediate future.

Copper and Tin

Current copper supplies in the United Kingdom are on a good scale, and not only are armament manufacturers getting plenty of metal, but some reserve stocks are being accumulated in various parts of the country as an insurance against the possibility of a temporary interruption in supplies at a later date. With new munition works coming into operation steadily total consumption must be moving upwards, and there seems no doubt that consumption here is now at an all-time record, but there seems nothing to suggest that prices will move from their present controlled level for the time being. The American market has been quite firm recently, a good demand having been in evidence at 11c. per pound delivered. Actual consumption by fabricators during July was 68,117 short tons, a slight drop compared with June. At the end of the month manufacturers there had unfilled orders on their books of 231,477 tons, but their net stocks of copper totalled 303,841 tons, or 72,634 tons in excess of their unfilled orders. On this basis they would appear to have no need to rush in to buy additional supplies. Nevertheless, consumption is expected to broaden during the autumn, and the copper outlook in America is regarded as good. . . . The trade demand for tin has been only moderate in this country, and on the Metal Exchange rather quiet conditions have prevailed. Prices, if anything, have been inclined to ease owing to some fairly persistent selling by smelters. The American market has also been quiet during the last week or two. The chief item of interest at the moment is the possibility of the erection of a tin smelter in America in connection with that country's rearmament and defence plans. Leading Bolivian ore producers are conferring with the authorities on the subject and it is possible that definite results may be achieved by the conference, since at the present time the American price of tin is much more attractive to Bolivian producers than is the English price.

Lead and Spelter

It has become increasingly clear during the last week or two that supplies of lead and spelter in this country are now on a satisfactory scale, at any rate so far as the essential requirements of the nation are concerned. Lead, of course, has been in somewhat easy supply for an appreciable time, but in the case of spelter the necessity for helping France in the matter of zinc supplies has put rather a strain upon the Empire resources in view of the high rate of consumption which has been maintained here lately, and which tends to increase as the armament drive intensifies. The Non-Ferrous Metal Control seems to be following the general Government policy of building up regional stocks so that essential production can continue here at the highest possible rate should transport facilities in any part of the country be temporarily interrupted. A fair amount of lead continues to be made available for export and home industrial requirements, but in the case of spelter, licences for other than war requirements are still granted somewhat sparingly, although there has been some relaxation as far as the export trade is concerned in recent weeks. Late last week the American quotation for lead was advanced to 4·90c. per pound, New York. The American market has had a firm tone for some time, but prices have been kept down to prevent too much Mexican lead being imported. As it is, considerable quantities have gone into bond in the United States. The American zinc market also has a good tone, and galvanisers there are operating at the highest level of the year. This, coupled with the upward tendency in the rate of operations at the brass mills, has kept the market firm at 6·50c., East St. Louis.

Notes and Memoranda

Rail and Road

The Late Edouard Michelin.—The death is announced, at the age of eighty-four, of Monsieur Edouard Michelin, founder of the well-known firm of pneumatic tyre manufacturers.

Train Services After Air Raids.—The Railway Executive Committee announces that the railways have been giving careful consideration to the running of train services for suburban passengers who may be delayed in consequence of late night air raid warnings. Following the air raid warning on Saturday night, extra trains were run from the main line terminals and by the London Passenger Transport Board to cope with the situation. A few passengers were unfortunately unaware of these emergency arrangements. In the event of a late night air raid warning in London the railways and London Transport will make every effort after the "All Clear" to ensure that the public get to their homes.

Station Facilities for Troops.—The War Office announces that arrangements have been made with the railway companies by which washing, lavatory and left luggage accommodation are now available to all members of the Services and corresponding Women's Services free of cost to them at ten main railway stations in London, and at main line stations in the provinces where there is a Railway Traffic Officer or a canteen recognised by the War Office. The London stations are King's Cross, Liverpool Street, St. Pancras, Euston, Paddington, Waterloo, Victoria, Charing Cross, London Bridge and Marylebone. The stations of the London Passenger Transport Board are not included in the scheme.

Rationing of Liquid Fuels.—In view of the confusion which appears to exist regarding the use of creosote as a fuel for road vehicles, the Municipal Passenger Transport Association has sought advice on the subject from the Minister of Transport. The Ministry states that it has been decided that all liquid motor fuels, whether imported or home-produced, must be treated on the same basis for rationing purposes. If operators wish to use benzole, creosote, or appropriate preparations of coal tar products, the total amount of fuel, whether alone or in admixture with petrol or diesel oil, should not exceed the equivalent amount of petrol or diesel oil of which the rationing authority would have been prepared to authorise the issue if no alternative fuel had been used.

Glasgow's Bus Washing Plant.—A bus washing plant forms part of the recently opened new extension to the Glasgow Corporation Transport Department's Knightswood garage, which is now capable of accommodating 280 vehicles. The plant, which was designed by G. D. Peters and Co., Ltd., of Slough, deals with the sides and roof of the double-deck buses, which are slowly driven through it. There are vertical and horizontal power-driven mops, which are operated at 50 r.p.m. by two 40 B.H.P. electric motors, mounted on the top of the superstructure. The motors and the chain drives are protected from spray. The vehicles are guided through the washer by concrete kerbs, and after washing are rinsed by two vertical sprays of clean water. Water for both the mops and rinsing sprays is supplied from the mains at town pressure.

Camouflage of Road Vehicles.—Although the Ministry of Transport does not at present require owners of vehicles to repaint them in order to render them less conspicuous, a number of private owners are apparently taking steps on their own account. There is no objection to this, provided that vehicles are not painted in a manner that resembles camouflaged Service vehicles. This was to be prohibited from August 26th, but in order to allow further time for compliance the effect of the Order has been postponed until September 23rd. Owners should not paint their cars with what is generally known as disruptive camouflage or with a jazz pattern. Cars painted in this way may be mistaken for Service vehicles, especially in a poor light. Whether one or more colours are used, it is best to keep to dark neutral shades in colours other than the greys and khaki already adopted by the Services. The paint, moreover, should always have a matt surface.

Railway Charges Deputation.—The Minister of Transport, Sir John Reith, together with the Parliamentary Secretary, Mr. F. Montague, and the Deputy Secretary, Mr. R. H. Hill, received a deputation from the London Transport Passenger Alliance on Saturday, August 24th. The Chairman of the Alliance, Alderman John Fitzgerald, explained the desire of the Alliance to present the view that the inquiry into railway charges—which opened on Monday, August 26th—should be postponed, and that the agreement between the Government and the railway companies should be terminated as soon as possible. The Minister stated that any application for postponement of the inquiry or for extended time to prepare a case should be addressed in the usual way to the Charges (Railway Control) Consultative Committee, who preserve full powers regarding procedure, and that on the subject of the agreement all he could say was that he was glad to have had an opportunity to meet representatives of the Alliance and hear their views.

Air and Water

Ministry of Shipping.—It is announced that Mr. Kenneth Stoker, managing director of Manchester Liners, Ltd., has been appointed the Ministry's representative for the Manchester area.

Two British Transports Torpedoed.—It is with regret that we record the loss of two British transports by submarine attack. The "Accra," formerly a fast Elder-Dempster motor liner, of the company's West African route, was sunk off the west coast of Ireland on July 26th. She was built and engined by Harland and Wolff, Ltd., at Belfast and was completed in August, 1926. She had a gross tonnage of 9337 and was propelled by twin-screw Harland-B. and W. oil engines with a total output of 5800 S.H.P. The other transport lost by enemy action in the Atlantic is the "Mohamed Ali El-Kebir," a twin-screw steamer of 7290 tons, which was registered at Alexandria and was owned by the Pharonic Mail Line. She was built on the Clyde in 1922. The British liner "Kemmerdine," a steamer of the Henderson Line, is also reported to be overdue.

The Late Mr. W. A. Johnson.—We note with regret the death of Mr. William Alfred Johnson, who was formerly staff foreman of works to the Southampton Harbour Board. Mr. Johnson, who was seventy-nine, was closely concerned with all the big development works carried out by the Board during the past half-century. He retired in 1930.

American Aeroplane Exports.—The United States Department of Commerce stated recently that exports of aeroplanes, aero-engines and accessories for the first six months of this year were nearly three times as great as those of the same period last year and more than double those of the latter half of 1939. The total value of shipments was £34,597,000.

Lifeboat Awards.—The Royal National Lifeboat Institution has made awards amounting to £46 to the crews of two lifeboats in the North-West who went out at the end of last month to search for an aeroplane that was reported to have fallen into the sea. Although they found nothing, these boats spent over six and eight hours respectively in this search.

The Port of London.—The accounts of the Port of London Authority for the year ended March 31st last show that the surplus from the revenue account was £1,558,137, as compared with £1,759,031 a year ago. The balance sheet also shows that capital expenditure stands at £41,937,149, an increase of £585,661, and that the general fund for maintenance, renewals and dredging has risen to £527,585.

Mercantile Losses.—During the week ended Sunday, August 18th, the mercantile losses due to enemy action included ten British ships totalling 41,175 tons, one Allied ship of 7590 tons, and two neutral ships totalling 4134 tons. This makes a total of thirteen ships aggregating 52,899 tons. It may be noted that the enemy claims to have sunk in this period 151,711 tons or nearly three times the actual recorded losses.

A Manchester Gift of Aluminium.—The Manchester Electricity Committee decided, on Wednesday, August 21st, to present 8 tons of high-grade aluminium to the Ministry of Aircraft Production. The aluminium has been recovered from underground electric cables which were installed during the last war, when there was a shortage of copper, and have since been put out of use. The value of the aluminium presented is estimated at between £500 and £600.

Tower Guns for Scrap.—Arrangements have been made to scrap the old French and English guns now acting as bollards on Tower Hill, London, and to pass them to the breakers for use in munition making. They are all over 100 years old, and most of them came from wooden men-of-war. Eight of the forty or fifty available have been removed from the kerb, and only those marking corners will be left. In addition, eight guns inside the Tower, weighing 25 tons, have been lifted and will shortly be removed by the scrap merchants. In all, about 150 tons of metal will be recoverable. The old war trophies, cannon, and mortars, along the river frontage and Tower Walk inside the Tower have also been earmarked for scrapping, but will be retained until the last possible moment at the discretion of the Master of the Armouries, in whose charge they are. Most of the trophies are bronze and some date back to the sixteenth century.

H.M. Submarine Losses.—The Secretary of the Admiralty regrets to announce that H.M. submarine "Odin" is considerably overdue and must be presumed lost. The ship was one of six submarines of the ocean-going type, and the name ship of her class, a sister ship, the "Oswald," was sunk some days ago. The "Odin" was completed at Chatham Dockyard in 1928. Her displacement was 1475 tons, with engines of 4400 S.H.P., corresponding to a surface speed of 17·5 knots. Her armament comprised one 4in. gun, two machine guns and eight 21in. torpedo tubes, six at the bow and two at the stern. A sister ship, the "Orpheus," is also considerably overdue and must be presumed lost. The Admiralty also announced on Tuesday evening that H.M. submarine "Spearfish" is considerably overdue and must be presumed lost. The "Spearfish" is a ship of the Shark class and improved Swordfish design, and was completed at Birkenhead by Cammell Laird and Co. Ltd. in September, 1936.

Miscellanea

Loans to the Treasury.—The Institution of Production Engineers has loaned to the Treasury without interest the sum of one thousand guineas, being the excess of income over expenditure for its financial year ended June 30th, 1940. The Institution of Chemical Engineers has decided to lend £2000 to the Government, free of interest, for the duration of the war.

Iron Ore in Ulster.—The decision of the Minister of Supply to send an expert to Ulster to report upon iron ore supplies in County Down is a reminder that from very early ages various deposits of the ore in Ulster were worked. Remains of large furnaces show that charcoal melting was carried out extensively. In one area of 167 square miles it has been reported that there exist over 180,000,000 tons of ore, and, in addition, there is a quantity of inferior aluminous iron ore which in years gone by has been found useful by English smelters for mixing in furnaces with foreign higher-grade ores. The richest grade is said to yield over 40 per cent. metallic iron. Mining in this area began to assume substantial proportions in 1861, and in the following year over 10,000 tons of ore were raised for export. The records show that 228,000 tons of inter-basaltic iron ore were obtained in 1880 and nearly 190,000 tons two years later. To-day there are no working iron ore mines in Northern Ireland. Some months before war broke out the Ulster Industrial Development Council reported that unlimited quantities of iron ore not containing a high percentage of iron existed in County Antrim.

The Diamond Cutting Industry.—Replying to a question in the House of Commons on Wednesday, August 21st, Mr. Harcourt Johnstone, the Secretary of the Overseas Trade Department, said that every effort was being made to organise the refugee diamond cutters of Holland and Belgium, in order to extend the industry and so increase our export trade. At least eight factories were in operation, engaging approximately 100 workers, and a larger factory would be started shortly, which should at least double the present output and engage a further 100 refugee specialists. British craftsmen were already employed and apprentices would be trained. The Government was giving every support to the promotion of this industry.

Decontamination of Electrical Plant.—The Electricity Commissioners have issued a report of a small committee convened by the North-Eastern Electric Supply Company, Ltd., to consider methods of decontaminating electrical plant. The original draft of the report was submitted to the Ministry of Home Security, and the copy now circulated gives effect to certain amendments agreed to by the committee to meet certain observations offered by the Ministry. The Ministry has expressed the view that the report is of value, as showing sound appreciation of the general principles which have been applied in a practical way to a specific problem. The Ministry therefore fully approves its circulation in its present form to electricity undertakers.

Underground Gasification of Coal.—An improved method for the underground gasification of coal has been worked out in the Power Institute of the Academy of Sciences of the U.S.S.R. by a group of scientists under the direction of Academician A. B. Chernyshev. The new method eliminates the need to sink shafts and drifts in preparation for underground gasification. Instead, two wells are sunk in the coal seam. After the combustion process is initiated underground, compressed air is blown into one well and gas issues from the other. The gas is then transported by pipe lines to the consumer. Experiments with the new method carried out under laboratory conditions during the past year have yielded positive results, and it is now planned to try it out in the Moscow coal basin.

Automatic Mirror Silvering.—It is reported from America that a leading manufacturer, after a long period of research, has introduced into the works a plant for the automatic silvering of mirrors. Overhead containers supply an ammoniacal silver nitrate solution, and a special reducing agent to a two-nozzle spray gun of special construction. The two solutions are atomised by compressed air and form a mist about 7in. in front of the spray gun nozzles. The silver begins to precipitate the moment the two sprayed solutions meet, and it is claimed that by this new method about 12 square feet of silver film can be deposited on a glass surface in less than sixty seconds. The deposit obtained, it is stated, is superior in uniformity, lustre, purity and toughness to that obtained by the usual method of glass silvering.

Cedar Rapids Power Station.—According to *Electrical World*, work is progressing rapidly on the extension to the boiler house of the Sixth Street station of the Iowa Electric Light and Power Company at Cedar Rapids. The steel work is approaching completion and installation of the boiler is well under way. Expansion of this station includes the installation of a sectional header, straight tube, cross-drum boiler capable of delivering 285,000 lb. of steam per hour at a pressure of 675 lb. and a total temperature of 750 deg. F., and also a 15,000-kW extraction condensing turbine. The turbine is to operate on steam at 650 lb. pressure and will be provided with four points of steam extraction. Pulverised bituminous coal will be burned, and the boiler has been designed to use also pulverised refuse from a Cedar Rapids cereal mill as a standby fuel.

Unemployment Insurance.—The Minister of Labour and National Service reminds employers and employees that under the Unemployment Insurance Act, 1940, on September 2nd non-manual workers remunerated at a rate exceeding £250 but not exceeding £420 a year become insurable against unemployment. Workers who will be brought into insurance should take steps to obtain unemployment books by that date from any convenient employment exchange. The books have been available since August 19th. Men of the age of sixty-five and over and women of the age of sixty and over who are affected by the new provisions will be insurable at the employer's rate only. They should apply for special Class P (X) cards at a post office. Non-manual workers also become insurable in Northern Ireland on September 2nd.

PERSONAL AND BUSINESS ANNOUNCEMENTS

E. G. Acheson, Ltd., has moved from Thames House to temporary premises at 9, Gayfere Street, Westminster, London, S.W.1.

Mr. R. Hugh Roberts, chairman of Fisher and Ludlow, Ltd., has been appointed by the President of the Board of Trade to be Director of Machinery Licensing. Mr. Roberts, who was formerly Deputy Director-General of Equipment and Stores, Ministry of Supply, will be responsible for the licensing of machinery and plant under the Machinery and Plant (Control) (No. 2) Order, 1940. His office is at 25, Southampton Buildings, Chancery Lane, W.C.2.

James Howden & Company (Land) Limited, Caxton House, Westminster, London, S.W.1, inform us that they have agreed to lend Mr. Norman Burke, Sales and Service Manager, to the Minister of Supply as from the end of this month until the conclusion of the war. During his stay with the Ministry Mr. Burke will, so far as his engagements there permit, still be remaining in constant touch with the firm and will retain an active interest in its work.